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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION.

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Education for the Engineering Industry—II.

We complete our review of the above report recently issued by the Board of Education with another quotation. The Committee acknowledges "the receipt of a memorandum from the Institute of British Foundrymen, and we take occasion in the body of the Report to refer to the admirable work done by this Institute." The quotation from the body of the report was that given in our last issue.

The Committee supports the raising of the school-leaving age to 15, and says that industry has no vital need for recruits before that age, and that the extra year's schooling, if wisely planned, must result in more intelligent and better equipped recruits. The report then mentions the great difficulty in recruiting boys for foundry work.

The Committee is markedly in favour of systematic training in the works, prefaced by a probationary period for the apprentice. Selection of apprentices and learners must be carefully considered, and they must be put on productive work as soon as possible. Finally, able apprentices should be transferred to higher grades of apprenticeship and have opportunities for promotion. Trade apprentices should be given an insight into closely-related trades.

As indicated in our last issue, the Committee is clearly in favour of those modifications to the ordinary national certificates in mechanical engineering which would make them suitable for founders. The fear was expressed in some quarters that the substitution of foundry subjects, supposed to be descriptive in character for those mathematical subjects like heat engines now taken, would weaken the intellectual training offered by a national-certificate course. We are glad the Committee has vindicated the views of those responsible for promoting the idea of a national-certificate course in founding; we should judge the phase rule as being as difficult for the mind to bite on as anything in internal-combustion engineering. Finally, the Committee agrees that crafts can only be learned in the shop and not in the technical school. We devoutly hope that our technical-school authorities will at long last get rid of that idea and of the idea that a little instruction in practical moulding suffices to meet the requirements of the foundry trade. It would not, even if it could be properly done in a school, which it cannot.

A note on the interesting Coventry scheme of apprenticeship completes the Report, which has the unusual addition of comments made on it by various bodies concerned with education, but these throw much more light on the interests of the bodies concerned than upon the Report.

Merchandising Castings—Overseas.

Whilst the Paper presented to the recent Birmingham Conference by Mr. Eric N. Simons on the subject of "The Merchandising of Castings" was extremely comprehensive, and especially suggestive, it failed to deal with the question of overseas representation. For instance, we have now made up our minds that no British foundry company is sufficiently wealthy to follow the advice of the Consular Reports issued by the Board of Trade. We have learnt by experience to anticipate the conclusions, which invariably reiterate the platitude that there is business to be done by British firms in Timbucktoo, Patagonia and every other remote quarter of the globe, providing that it is personally and frequently visited by a responsible director accompanied by technical experts who speak the language of the country. The cost of such mondial representation, when suitable trade literature—in the language of the country—is added, is more than an individual firm can stand. Surely, it is the business of the large merchant houses which, having a mixed business with one or more foreign countries, should try to develop new lines. The moment these developments look really promising then the manufacturing establishments should be called in, and the tenets of the Consular Reports may be followed faithfully. Broadly examined, any fifth-rate country has some outstanding business with Great Britain, and it appears to us that the best way of promoting new business is to search out the British firms engaged in this major trade and to utilise their organisations for preliminary surveys. We deem this preferable to an extensive approach to the consular authorities, as they are usually too enthusiastic about the potentialities of their particular territory and probably not cognisant of the indirect cost of certain foreign orders. If directors and high-grade technicians are worth their salt, they cannot be spared for other than the most important territories from their particular angle.

The cost of sending a director and a technical expert for a six months' tour of South America, South Africa and Australasia in any one year would probably amount to £6,000 in direct expenditure, to which must be added such indirect factors as salaries, catalogues, business delays, and loss of personal touch with people who expect to see them in their own works. It is on these grounds that we advocate thorough market analysis through British firms already well established in any Dominion or foreign country. The result, coupled with the Consular Reports on general conditions, should form a concrete basis on which to make a decision before spending money on huge travelling expenses.

XUM

The British Cast Iron Research Association.

II.—CONDITIONS OF MEMBERSHIP.

The Cast Iron Research Association is essentially an Association of manufacturing concerns in the industry, and ordinary full membership is open to all such firms, whether they be limited companies, partnerships or privately owned. By virtue of the original constitution of the Association membership is confined to British subjects and British firms. Members may come from any part of the Empire, but individuals must be British subjects, and in the case of limited companies at least three-quarters of the issued capital must be owned by British subjects in their own right. This provision may be modified by special permission of the Board of Trade where a company having a larger proportion of foreign capital operates in Great Britain and employs British labour. It reflects the conditions prevailing immediately after the war when exclusive technical knowledge conferred a tremendous advantage on the country possessing it, and is occasionally adversely criticised by founders in foreign countries who desire to see advances published for the benefit of all, but they overlook the fact that the B.C.I.R.A. has no parallel on the Continent, and even in the United States of America the technical bodies formed in the industry to deal with malleable iron, grey iron and steel are commercial rather than technical in their aims. The nearest approach is the recently formed Ontario Metal Industries Research Association. The Government of the Province of Ontario has recently built a splendidly-equipped laboratory costing altogether about £60,000, of which this new body may make use. The contributions to scientific and practical foundry knowledge published through the Proceedings of the Institute of British Foundrymen, a number of which are furnished by the B.C.I.R.A., are not exceeded in technical value and importance by those of any other foundry association, and the B.C.I.R.A. is entirely within its legitimate rights as well as within its constitution in circulating reports to its subscribers which are not broadcast.

Classes of Members.

Ordinary Members.—The keynote of the Association's work is founding rather than cast iron, and the following firms are eligible for ordinary full membership:—

(*a*) Blast-furnace plants producing foundry pig-iron, and plants producing refined iron, in any type of furnace.

(*b*) Grey and white iron foundries, including those producing all kinds and types of grey, chilled and white iron.

(*c*) Malleable ironfoundries, including those producing white-heart malleable cast iron, black-heart malleable cast iron and steel alloy.

(*d*) Steel and other foundries.

In special circumstances the Council may elect to full membership firms not actually having foundries, but who are interested or concerned in cast metals and foundry processes.

Terms of Ordinary Membership.—The terms of membership have been considerably simplified in the new scale recently adopted. For each plant, that is each blast furnace or foundry, in the above-mentioned classes, there is a minimum annual subscription of 25 guineas. This applies to each foundry unit in a given works, so that for membership effected in respect of two foundries, say a grey iron and malleable foundry, or an iron and steel foundry, the annual subscription is 50 guineas. The maximum subscription for any one works is 100 guineas per annum, equivalent to four such units. Furthermore, for ironfoundries, the 25 guinea minimum applies to those employing up to 250 hands (that is on weekly wages or on payment by results, excluding clerks, engineering machinists and patternmakers). Foundries employing 250-500 hands count as two units for subscription purposes; from 500-750 as three units, and over 750 as four units, equivalent to the maximum subscription.

Trade and User Members.—The Council also appreciate co-operation and support from two other important sections of the trade. The first of these comprises firms manufacturing or distributing foundry equipment and supplies. The interests of such firms are identical with those of makers of castings, inasmuch as both depend on a strong, stable and prosperous industry. The second group comprises users of cast iron who are mainly the great engineering, shipbuilding, textile, agricultural, mining and other firms, gas, water and electric power companies, etc., who buy cast iron but do not possess their own foundries. These two classes are invited to support the Association by means of a small annual subscription of 5 guineas per annum, which such members may voluntarily increase if they so desire. Such additions qualify for grant. They have full voting rights as members, but do not receive confidential research reports.

Associate Members.—There is one other grade of subscribing member, the Associate Member, who subscribes as an individual and not as a firm, and who receives the Quarterly Bulletin and Library service, but no research reports. The main object of this grade of membership is to enable persons interested in the work of the Association to keep in touch with it until such time as they are able to persuade their principals to arrange to join as ordinary full members. This grade has fully justified itself from this point of view. The annual subscription for this grade is now 21s. per annum, at which figure it is hoped that many will join. Members of the Institute of British Foundrymen retain the right to become Associate Members at 20s. per annum.

The work of the association is assisted by two further important classes of members, Honorary Members being distinguished scientists and industrialists and Delegate Members appointed by various technical and scientific societies.

How the Association is Governed.—The Association is governed by a Council which is fully representative of the various sections of the trade and which is elected by members at the Annual Meeting. The Council functions through three main committees: the Research Committee, the Publications Committee, and the Education Committee. The Research Committee controls the research policy and the research programme, the actual details of individual investigations being dealt with by sub-committees of the Research Committee composed of experts in their particular spheres. There are at present nine such sub-committees: six of these deal with broad sections of the trade; Pig-Iron Sub-Committee, Grey Iron Sub-Committee, Nickel & Alloy Cast Iron Sub-Committee, Malleable Cast Iron Sub-Committee, White & Chilled Iron Sub-Committee and the Light Castings Sub-Committee. Other important matters of common interest to the trade as a whole are dealt with by three other sub-committees: the Sands & Refractories Sub-Committee, Tests & Specifications Sub-Committee and the Cupola Sub-Committee. On these sub-committees and the smaller panels formed from them for special purposes there are over 100 members, representing over 80 subscribing members of the Association, and the co-operation and suggestions of all members are welcomed at any time. The Publications Committee supervises the Library and Information Bureau, the issue of published matter to members and the holding of private meetings of members, while the Education Committee represents the Association's interest in the education and training of foundrymen. In

(*Continued at foot of next column.*)

Random Shots.

Not every day is it that one wants a bath—of cast iron, that is. And rarely, I imagine, does a householder purchase an enamelled iron bath as he would a cigarette lighter or socks, at a shop counter. A well-known London stores, however, in the advertisements of its summer sale, is offering to the public, "at an unprecedented price," baths which are described as being slightly imperfect, and which, I believe I am right in saying, are of foreign manufacture. Whether the price is unprecedented or not I do not know; sufficient that it is amazingly low. "Slightly imperfect" may or may not imply the skilful welding of defects, whilst in this case "foreign" and "imported" are synonymous. To me it seems a great pity that, at a time when our own bath manufacturers are being compelled to reduce wages, this stores should advertise for sale cheap, second-grade imported baths. Really, I shall have to write to Mr. Frank Russell about the matter!

* * *

But, as I have said, householders are not in the habit of buying baths at the counter. The normal procedure is somewhat less simple, but has one decided advantage. The procedure is this: You consult a builder, haggle with him on the point of cost, give way, and get your bath late rather than soon. The builder, in turn, haggles with a builders' merchant; the merchant does not give way. Given sufficient builders, periodically the merchant haggles with a foundry owner, and still does not give way. The decided advantage is a public-school education for the merchant's sons.

* * *

If I appear to have said too much of baths, remember—they are indispensable for the Americanisation of civilisation!

* * *

A pigeon's nest of steel and "nickel" turnings was recently discovered in the engine-shop of a Belfast works. If it were the common practice of pigeons to incorporate nickel turnings in their nests, Ward's and Cohen's would have to open up bird's-nesting departments.

* * *

Imaginary Intimate Interviews.

XI.—*The Cinema Proprietor.*

I have a sense of duty to the great British cinema-going public. If they demand the opening of my cinema on Sundays, who am I to seek to frustrate their wishes? And who are my staff? They, too, should have a sense of duty to the public. They should, as I do, subordinate personal feelings to the wishes of the great British cinema-going public. Mind you, I can sympathise with those people who accept the Sunday opening of cinemas as a sign that the country is going to the dogs. But the country has been going to the dogs since I was a child, and has not yet got there. And why go to the dogs?—why encourage greyhound racing?—when one can go to the cinema and enjoy all-American films. Think of the hospitals—the patients who would be deprived of their grapes and thermometers if I were to refuse to open on Sundays. It would be uncharitable of me! And, let me whisper to you . . . think of overhead costs spread over seven and not six days. Think of it!

Marksman.

(*Continued from previous column.*)

addition the Falkirk Technical Institute, which is the Association's laboratory in Scotland, is governed by a strong Scottish committee.

The Association is thus democratically governed and the organisation of the sub-committees and committees is such that business is carried on with the minimum of duplication and overlapping.

The Merchandising of Castings.*

By Eric N. Simons.

The old conception of the method of making sales laid too much stress upon the "ales" part of the word. I am not a devotee of the "ales" school. Whoever is will not appreciate this Paper, and should seek comfort (and refreshment) where he will find more welcome views. I do not like the word merchandising, which has been imposed upon me. It is a long way of saying "selling," and selling castings is my real subject.

The thing required is to *increase* sales of castings, not merely to keep them at their existing point, nor to prevent their declining. This may sound a platitude, but it is not. It is an essential point. Selling must, if it is to be successful, be aggressive. Maintaining sales is a defensive attitude. It may succeed in its object, but it will do little more. I take in this Paper the point of view that the selling of castings should be an aggressive action, an action, that is to say, in which the first and foremost aim is to win something one did not previously have, not merely to keep what one already has.

Aggressive Selling.

Aggressive selling begins, then, with the management. Candidly, I am critical of certain foundry managements. There is, I perceive, a tendency to "kow-tow" far too much to the representative "on the road." There is a tendency to imagine that, because a certain representative sends in orders with comfortable regularity, he is a tip-top man, and must be neither controlled nor instructed, nor in any way have his methods subjected to constructive criticism. In consequence, because his turnover may be, let us say, £20,000 per annum, as against the £10,000 annual turnover of some other representative in a different district, he is looked upon and treated as a star salesman, and in anything relating to his territory his word is law.

But the essential thing from the foundry management's point of view is not what that representative's turnover is, but what it should be. If the actual potential turnover for a given district is £40,000, then the £20,000-turnover man is not a "star" at all. If the actual potential turnover in the other man's district is £12,000, then he who secures £10,000 is certainly a "star." By actual potential turnover I mean the amount of business that a firm may safely consider its legitimate share of the market, not the entire purchasing power of the market.

Changed Conditions.

Now the "ales" school of representatives has this strong point, that by their methods they may, and generally do, secure a number of good old cronies, who, in the intervals of pulls at the beer-handle by the barmaid, give them excellent orders, and these orders, taken *in toto*, may tot up to a good turnover figure. In the old days it is possible—though I doubt it—that theirs was the best and simplest selling method. But to-day, in the face of tremendous industrial depression, the situation has completely changed. Modern buyers are, in the majority of instances, an altogether different race. With the development of mass production, with the increase of competition in all directions, it has been recognised that the buying department is one of the most important sources of profit or loss. A difference of a farthing a pound in the purchase price of a commodity may, when translated into selling price of the finished product, decide whether the market is to be captured or not. I venture to assert that buying "from a friend," for no other reason than personal friendship, is less practised to-day than at any other period in industrial history.

Basic Principles of Buying.

On what principles, then, is buying done? It is done, except where inefficiency reigns, on the principle that the firm offering the best materials at the most reasonable price and giving the most efficient and helpful service will get the orders. I stress here the factor of efficient service, to which I shall return later.

It follows, if what I have said is accurate, that while the "ales" school of representative, the man with a plausible tongue and a limited knowledge of his firm's specialities, may, and does secure a percentage of business by his methods, he cannot, by very reason of those methods, secure anything like a satisfactory proportion of the actual potential turnover. The keen buyers have no time for him; the able buyers find he cannot solve their problems without irritating delays while he refers their questions to the foundry; the buyers who know on what a precarious thread even the best of jobs hangs to-day dare not confide themselves to him blindly. Behind the big buyer to-day sit the cost accountant, the production manager, the sales manager. He dare not go haphazardly where they are studying every step.

MR. ERIC N. SIMONS.

Mr. Simons was born in 1896 and educated at the King Edward VI School, Birmingham, and the Central Secondary School, Sheffield. He joined Edgar Allen & Company, Limited, Sheffield, in 1911 as office boy, was appointed publicity manager in 1919 and last year became assistant sales manager. He has represented the company in France, Russia, Switzerland, Central Europe and the Balkans. During the war Mr. Simons was transferred from the Artists' Rifles to the Military Intelligence Contre-espionage Department, and after the Armistice to the Demobilisation Directorate. He is a member of the Russo-British Chamber of Commerce and of the Engineering Committee of the Incorporated Society of British Advertisers. He speaks three languages and is the author of numerous books upon business subjects.

Again, it follows that the representative of the "ales" school will, perceiving how he stands to lose by an impartial and efficient study of his methods and territory, fight tooth and nail to prevent any such investigation. He will resent control by a sales manager. He will ignore anything that suggests an analysis of his results. He will point fiercely to turnover figures, and scoff at the suggestion that he may be missing business. He will ignore hints from the sales promotion department as to potential markets, for the reason that to acknowledge their value would be to confess ignorance on his own part.

The Policy of *Laisser-Faire*.

And now by this devious route I come to the besetting sin of foundry managements, which is their all too great readiness to accept these defensive gestures, these offensive recriminations, on the part of their representatives, and shirk the impartial, scientific inquiry into territories, from the sales point of view, that they should make. Confronted by an irate representative, their instinct is always to placate, to temporise. They do not "want to upset" Mr. Smith. After all, his turnover last year was £20,000, and it wouldn't do to lose it. And so they go on letting Mr. Smith turn over his annual £20,000, as he certainly does for a time, until one day they wake up to the fact that competitor A is turning over £50,000 from that territory, and competitor B is turning over £40,000 and competitor C, a little man, whom they despise, is turning over £30,000. Then it is too late. The market has gone. If Mr. Smith is persuaded to retire, or politely stimulated in those mysterious ways known only to sales managers, his successor or he himself finds that "we are satisfied with our existing suppliers and do not propose to change."

Market Analyses.

The first requisite of successful selling of castings is, therefore, a close study of the market in the various territories covered. At this juncture the management may very well retort that its business is to manage, not to pore over blue-books and maps. My combative chief, Mr. G. Ernest Wells, would probably put it more forcefully than that. And I should agree (and have agreed) with him. It is not the management's business to make these investigations. The management's business is to see that they are made. And only too often the management forgets that. The person whose business it is to make these investigations, not necessarily in person, is the sales manager. Every efficient foundry should have a sales manager. If the foundry is small, he may also be half-a-dozen other sorts of manager, and often is. The point is that there should be a directive influence over the representatives, checking, controlling, studying and stimulating them, measuring their achievements and preventing them from imagining, as they are only too ready to do, that truly they are the people. And that directive influence should be an individual, not a board of directors—too often, if I may be iconoclastic, boards are wooden.

Functions of a Sales Manager.

Fortunately, I can speak enthusiastically of a sales manager's value, since I am not one myself, but only a humble assistant—or perhaps humble is the wrong word in this connection. But what is of more interest is an outline of his functions. These I enumerate, without superfluous comment:—

(1) To recommend changes of selling policy to the management, or to whoever is responsible for carrying on the foundry, whenever such changes are necessary; or to confirm the policy already in force.

(2) To execute efficiently the policy decided upon.

(3) To analyse the market.

(4) To control representatives and agents, to check their results, and, where possible, to improve these.

(5) To sell the product actively.

(6) To make full use of subsidiary departments, *e.g.*, sales promotion, publicity, delivery department, statistics, etc.

(7) To draw up all agency and representative agreements, and to supervise all selling arrangements and contracts.

* Paper presented at the Twenty-Eighth Annual Convention of the Institute of British Foundrymen.

Space does not permit me to dwell upon the minutiæ of sales management. For the present, therefore, I will turn to this most important factor of market investigation. There are six main headings under which all market information may be grouped:—

(A) What industries use or are likely to use the castings?

(B) Do they all use the castings in the same way? If not, can they be grouped according to the use they make of them?

(C) How are these industries situated? What is their relative importance in terms of capital and labour employed? How do they compare with each other in regard to the amount or numbers of the product they can absorb?

(D) On what principles does each industry buy?

(E) What is the best means of selling to each industry or group?

(F) Will the castings suit each industry without modification of material, analysis, design, etc.?

Analyses of Potential Demand.

These form a satisfactory basis on which to build up the efficient marketing plan. I now turn to the subordinate, or, rather, more particular questions, of which a list is given:

(1) Is the product a novelty, a specialty, or a standard article? In other words, is it on the market for the first time, is it peculiar to one foundry alone, or is it a product widely known and used, and made by many competing foundries?

(2) Is it a standard article in every industry in which it is used?

(3) Are its applications standard applications in every industry?

(4) What special features make it suitable for the various industries enumerated?

(5) Of what intensity is the competition?

(6) What industry affords the greatest likelihood of rapid sales? And why? What obstacles do the other industries present?

(7) Past, present, and probable future state of trade in each industrial market? Relation of this to volume of castings absorbed?

(8) How do prices compare with those of home competitors? What is the relation of these prices to the savings, if any, that can be effected by the consumer using the castings?

(9) Any foreign competition? Any competition from castings of a different character or composition, but fulfilling the same purpose? Any competition from forgings? How do prices compare in these instances?

(10) What does it cost to pack and deliver the casting (*a*) to station, (*b*) to customers' works within various stated radii, (*c*) f.o.b. various stated ports, (*d*) c.i.f. certain stated ports, (*e*) franco certain stated foreign or overseas towns? What is the custom in regard to payment of these charges?

(11) Are the castings bought for direct use as an accessory to some other product, or as an integral part of some other product, into which they are built?

(12) Are they bought for re-sale at all?

(13) Is it necessary to carry stocks? If so, standard sizes?

(14) Are the castings to be branded or labelled or marked?

(15) Do the castings have to pass physical tests? If so, what, and by whom designed and carried out? Cost of these?

(16) Who does the buying in each industry, and on whose recommendation are orders given out—*e.g.*, purchasing agent, chief engineer, works foreman, production manager, etc.? Who buys when the castings are for re-sale?

(17) Can repeat orders be obtained, or does each successful sale mean a customer "dead"?

(18) Can orders be obtained for accessories or repairs?

(19) Is service necessary after the castings have been sold, to ensure that the customer is satisfied? If so, what is this likely to cost in relation to the selling-price?

(20) What is the smallest order on which a worth-while profit can be obtained? Will it pay to refuse orders smaller than this? What industry gives the largest average orders, and what is the size of these?

(21) Is the sale constant, irregular, or seasonal? What factors govern the fluctuations of demand? Can demand be stimulated or influenced?

(22) Percentage of sales costs in relation to (*a*) selling price; (*b*) profits; (*c*) total turnover?

(23) Is it necessary or possible to sell through retailers?

(24) Amount of competitive advertising? Its character? Media chosen?

Sources of Information.

A close and comprehensive review of his position, such as is furnished by the above catechism, puts the founder in touch with every aspect of the marketing problem, and enables him to plan scientifically. And whence, the question naturally arises, is all this information to come? There are various methods, all of which depend upon the size of the foundry, the extent of the investigation, and the purpose with which it is initiated.

(1) Special investigators may be sent out to study each market or group of industries and prepare a report.

(2) The statistical information furnished by various Government reports and blue books may be judiciously combined with the information obtained on the spot by experienced salesmen.

(3) Valuable information may be obtained from trade journals, and associations, their records and compilations, from the census returns, from trade directories, telephone directories, etc. Most of this is, however, of a generalised character.

(4) A section of the market may be localised, and a preliminary campaign conducted against that section only, with the object of securing trustworthy guidance as to the reactions of the market as a whole by the behaviour of one average section.

Whichever combination of methods is employed, the results obtained should be carefully analysed, tabulated, and charted, so as to simplify presentation of the essential data. Consumption figures for each industry can be clearly indicated by graphs. Tabulation of sales data is another convenient form of presentation.

Internal Investigations.

In addition to his external investigations, the sales manager must make internal investigations, since an accurate knowledge of all the factors affecting sales is indispensable to him. He must obtain from the statistical section of the business, whether this be a sideline of the accounting department or a separate section on its own, certain details, listed below:—

(1) Total sales in all departments of the foundry for the period he reckons as a unit, *e.g.*, one month or one year.

(2) Total publicity and advertising costs for the same period.

(3) Total sales of each individual department for the standard period.

(4) Proportion of publicity and advertising expenditure absorbed by each department.

(5) Total expenditure per standard period on selling costs, as distinct from publicity and advertising, *e.g.*, circularising, salesmen's expenses and salaries, overhead charges, etc.

(6) Comparative figures for previous periods in each instance.

(7) Total number of new inquiries and new accounts over the standard period.

(8) Total value of new accounts.

(9) Distribution of new accounts according to representatives' districts.

(10) Percentage of new accounts and inquiries directly traceable to (*a*) advertising, (*b*) representatives' efforts, (*c*) catalogues and sales literature, (*d*) circularising, (*e*) exhibitions.

Obviously, the above list does not exhaust the facts the sales manager will need to know before his job is ended, but it is not my plan to dwell on details.

Marketing Policy.

Having a fund of information of a fairly trustworthy character at his disposal, the sales manager must—if the business be such as allows its selling policy to be regarded as a definitely consistent whole—decide upon a comprehensive sales policy, which can be expressed in concise form and circulated among the various persons and departments affected, all of whom should be invited to criticise or comment upon it. It will also be found a good plan to consult the service department of a technical journal of high standing or influence (I can see my friend Faulkner pricking up his ears at this!). Many journals are only too glad to contribute helpful advice on and criticism of marketing schemes, and their extensive knowledge of market conditions in the industry they cover enables them to point out many factors that might otherwise be overlooked. They can give information on trade conditions, the psychology of buyers, the needs and characteristics of a particular market.

It may be asked what a sales policy is exactly. The best answer I can give is that it is knowing what you want to do and deciding how you are going to do it. Every foundry has its own idea of a sales policy. Some have half-a-dozen different sales policies, and use them all, with chaotic results. But the clearer, more definite your notion of what you are out to do, the more likely you are to do it. It may be your selling policy to ignore the retailer and go to the wholesaler; to sell to particular groups of industries rather than to all and sundry; to dispense with outdoor representatives and rely upon direct mail; to refuse to replace defective castings unless they are returned to you for inspection. There is no limit to the variety and detail that can be introduced into a selling policy. The point is that you should clearly formulate your policy, see that it contains no self-contradictions, and act upon it, at all events until it fails to justify itself.

Phases of a Selling Campaign.

Then comes the actual execution of the sales policy, which may be called the sales campaign. Seven divisions of activity represent the fulfilment of a sales plan, as follows: (1) Outdoor selling; (2) advertising; (3) circularising; (4) selling by printed matter; (5) expert demonstration; (6) exhibiting at fairs, trade shows, etc., and (7) overseas agency work.

Sometimes it is necessary either to put a new type of casting on the market, to give a general fresh impetus to sales, to clear out stocks, to extend the uses of the castings, to open new markets, or to stimulate falling sales. In such instances, it may be desirable to run a special campaign over and above the ordinary selling activities, a kind of "big push." This may involve special advertising, specially-prepared literature, extra circularising, and even, where circumstances warrant it, a temporary increase of the selling force, or a reduction in prices.

In the course of these notes I shall not refer to these branches of selling activity in detail. For the moment I wish to concentrate specially on the question of foundry salesmen, because this, after all, is a matter that concerns every founder who employs outdoor representatives, and it is one of the most difficult and important problems to be solved in selling.

I have hinted earlier that foundry representatives of the "ales" school are definitely a race that is dying out, should die out, and must die out, for the good of industry. I have hinted, too, pretty plainly, that foundry managements have been inclined in the past to let their representatives build up for themselves fictitious reputations based on aggregate turnovers, without reference to market potentialities. Finally, I have declared roundly that representa-

tives, whether of the "ales" or "sales" variety, should be controlled, and controlled by an individual.

Modus Operandi.

That is a fairly easy thing to say, and if I were in the unfortunate and painful position of having to read and digest these remarks, I should find myself at once exclaiming: "Yes, but how am I to set about it?" If I cannot answer that question, I may as well confess myself ignoramus, which by character and inclination I am most reluctant to do. Here then are the answers:—

(1) Representatives should be given clearly to understand that their first and foremost duty is to follow up as quickly as possible all important inquiries. This, of course, is A.B.C.

(2) For the rest, they should not be allowed to wander at their own sweet will over the face of the globe. I hold strongly that a traveller's routes, subject to proviso 1, should be planned, not merely haphazard. (I am afraid my firm's sales manager, Mr. H. Donald Boyd, will not thank me for making this suggestion. He has enough to do already.) I believe that there is everything to be said for certain districts, or, rather, the firms in those districts, being able to reckon on a visit from the foundry representative every certain period.

It often happens that a job crops up, for which castings may be suitable. The firm concerned, if it cannot count with some certainty on a visit from the foundry representative within, say, a week or so, will put the job out as an inquiry to various foundries. But if, by a process of quick calculation, the buyer or production manager can say to himself: "Oh, it is three months or so since Jones, of Brown's, was here. There was a card yesterday to say he will be calling some time within the next week or so, I will have him in and put it up to him," the probability is that Jones will walk away with the order. This may not happen in a large number of instances, but if it happens at all, it is an argument in favour of planned routes. Planned routes enable the sales manager to send some sort of general notification to firms upon whom the representative will call. They enable him to fix appointments in advance. In short, it is plan against confusion, system as against disorder. There are difficulties, but they can be overcome if the will is there.

As to who should plan the routes, I am not worried. The sales manager may do it, or the representative himself; but the sales manager should have a right to study and approve the representative's plan in the latter instance.

Emergency Planning.

I dwell upon this question of planning because it seems to me important. It is agreed that important inquiries should be followed up at once. This is usually left to the representative's good sense. But so is the rest of his route, and not all salesmen possess good sense. To my mind, the sales manager is as able as the representative to decide what inquiries should be followed up, and it seems to me that in a well-organised sales department, the sales manager should issue each night a route instruction on the following lines:—

"To Mr. Jones.

The following inquiry should be followed to-morrow:

John Smith & Company, Limited, Liverpool. 2,000 aluminium castings.

You should make a point of also calling upon the following firms while in Liverpool:—Jones, Robinson & Company; Hobson, Hobson & Company, and Brown & Bronson, Limited. If time allows, visits to the undermentioned will also prove of value."

Of course, in practice the scheme would not operate so simply. There might be two or three important inquiries on the same day, far apart, *e.g.*, one in Liverpool, one in Lancaster, and one in Preston. But any system should have a measure of flexibility. Planning schemes on these lines can easily be elaborated by founders for themselves. What I am insisting upon is the need for planned routes.

Lapsed Accounts.

(3) Salesmen should not be allowed to let accounts lapse. They should be notified week by week of a limited number of firms (preferably the most important) who have not ordered castings over a given period (*e.g.*, six months). And it should be made clear to them that they must call upon those firms during that week. The firms would, of course, be chosen according to the district the representative was likely to visit. Where the firms were small, or in out-of-the-way places, so that it would be inexpedient to compel the representative to visit them specially, the sales department should write to them, pointing out the decline in orders and generally trying to retain contact.

(4) Looseness in the furnishing of expense accounts should not be allowed. All expense accounts should be detailed monthly under various headings, *e.g.*, railway fares, car insurance, petrol, meals, tips, garage fees, etc.

Salesmen's Delinquencies.

(5) Failure to answer queries or letters should not be tolerated. I was interested to watch one foundry salesman go through his letters the other day. It was amusing to watch him rip up this with an expletive, tear up the other with "Oh, be damned to that!" and so proceed until he had reduced his post to a few letters crammed anyhow into his pocket. But it was also, to one with an orderly mind, painful. I happen to know that that particular representative is most difficult to draw replies from, is invariably excusing his failure to reply by saying that he has never received communications, or has mislaid them, and, in short, conducts his correspondence in a most inefficient and unsystematic manner. The marvel to me is that he "gets away with it."

(6) Salesmen should not be allowed to spend what they like on presents, Christmas-boxes, etc., and debit the foundry with the lump sum. If they wish to spend extra money in this respect, they should first indicate the sum they propose to spend, and ask permission.

I could give other instances in which control should be exercised, but I have said enough to be provocative, and that satisfies me. In my indignation at the slackness that allows salesmen to behave as though they were the be-all and end-all of business, I may have gone to the other extreme. But I hope that what I have said will not be taken as in any way an attack upon representatives as a body. What I have attacked is slackness and arrogance, disorder and incompetence.

Technicians as Salesmen.

And now let me give a few suggestions as to the type of representative whom I consider ideal as a seller of foundry products. From first to last, the technical salesman, which includes the foundry salesman, has to work by logic and reason. He must eliminate mere rhetoric from his equipment. To be able to convince the men he meets that his castings are worth buying, he must have a good deal of technical knowledge in addition to sales ability. He must be prepared to answer accurately questions of considerable technical importance. Are his castings safe at a tensile strain of so many tons to the square inch? What is the reason for the failure of another type of casting or of a forging when used for a particular part? What type of casting (*i.e.*, material) would he recommend instead? How long will his casting last as against one in some other material?

The best technical salesman will sometimes meet questions they cannot answer offhand, but they should be able to convince the buyer that although they are not, perhaps, experts, they nevertheless know what they are talking about, and have not merely learnt by heart a few technical facts and figures for talking purposes. They must be able at a pinch to suggest a slight improvement in design. They must have so thorough a knowledge of industrial methods and requirements that they can put themselves in the customer's place, and point out ways in which money can be saved by use of the appropriate castings.

The ideal foundry salesman is one who has had several years of good foundry experience, and possesses also those general qualities of vigour, confidence, imagination and tact, that make for salesmanship.

Such men are not easily found. The trouble is that foundry managements have not paid enough attention to this need for trained and efficient salesmen of their goods. In consequence, they have taken no steps to secure or guarantee a supply. The young men in their drawing-offices have gone to various posts in the works or offices, without ever being made to realise the opportunities elsewhere. Yet hundreds of young men training to become engineers or foundry managers, none of whom will ever rise to more than an under-manager's position, if they do not remain in the drawing-offices, would, with a little training and encouragement, make splendid foundry salesmen. The foundry salesman does not need to be a foundry genius. He needs foundry experience and knowledge—the groundwork that many of these young men acquire as a matter of course—plus those qualities previously outlined. It is much easier for a young engineer to learn salesmanship than for a salesman to learn engineering.

The foundry management with foresight should instil into its young draughtsmen, from the time they enter the drawing-office as tracers or run-about lads till the time when their inclinations and abilities are clearly perceptible, the notion that it needs a certain proportion of them to train for salesmanship. In this way the foundry will always have a reserve of eager young men with experience and foundry knowledge ready and willing to represent it in any part of the world.

Foundry Advertising Department.

The sales department should help the foundry salesman in every way possible. The salesman should be notified immediately any change of policy is decided upon, and he should meet the sales manager regularly for a discussion of urgent problems. The advertising department—non-existent in most foundries, and regrettably so—should explain its proposed plans to him, and the reason for them. Every bit of market information the sales department receive should be forwarded without delay. Edgar Allen & Company, Limited's sales department regularly go through the "contracts received" pages of every trade journal that covers a market for their products, and notify the representatives of contracts received by important customers in their districts. In this way representatives are able to follow the path of business, and do not waste calls on firms whose plant is idle. The advertising department should supply representatives with pulls of each new advertisement published. This keeps them in touch with what is being pushed, furnishes them with new sales-points, and enables them to criticise anything they do not agree with. There is also much to be said for the policy of sending them also copies of competitors' advertisements, to enable them to prepare answers to the claims made, to see wherein lie the points of difference between their products and those competing, and to keep them in touch with what competitors think it is advisable to push.

Authentic testimonials are an asset any foundry salesman is glad to have. Duplicates of these should invariably be circulated among representatives. Works departments should supply the representative *via* the sales manager with new facts about the castings or the pro-

cesses by which they are made, or the facilities for producing and stocking them. They should notify him of any changes in composition or application.

Additional Activities Indicated.

In this Paper I have concentrated primarily on the direct-selling end of the foundry business. I have carefully kept in the background such important matters as sales promotion, advertising, publicity, exhibitions, keeping of sales records, circularising, expert demonstration and all the indirect aids to selling. My reason is that to deal with all these adequately would demand (and has, in fact, demanded) an entire book. I have judged it better to confine my remarks, which, I hope, will be found provocative, to those directions in which it seems to me that foundry selling is faulty, imperfectly organised or capable of improvement. I have not gone into extensive detail, for the reason that systems are often incapable of effective translation from one foundry to another, owing to ineradicable differences of organisation. Any points that may have been insufficiently dealt with here can, of course, be raised in the discussion, when I shall endeavour to present a full and informative reply to the questions asked.

My experience has been that principles precede details. Granted the principle, and the details can always be worked out by competent people. But it is in their failure to admit the primary principles that too many foundries go wrong. They will not control their salesmen as they control their clerks or managers; they will not study their markets; they will not advertise; they will not analyse their sales costs; they will not secure consistency in their agency and selling agreements; they will not furnish their sales force with ammunition in the way of selling points, prices, information and literature; and until they are prepared to concede that these things are in principle necessary, it is useless to go into elaborate plans for achieving objectives. That must be my excuse for not presenting in this Paper a mass of charts and graphs and tables, of forms and diagrams and schemes. I can give all these things when they are wanted; but I do not think the foundry industry as a whole is within a hundred years of wanting them.

DISCUSSION.

Mr. F. J. Hemming (President, Birmingham, Coventry and West Midlands Branch) emphasised that, as Mr. Simons had pointed out, the trouble in the foundry industry was that, when men were fighting for their lives, there was a tendency to accept too much work at undercost in order to keep the foundries going; whereas if they followed some of the laws, or commandments, laid down by Mr. Simons they might be able by united action to force themselves into a better position than they occupy at present. The careful analysis of markets and the necessity for regarding customers not so much in a personal light but more in the light of politics were important. Reference had already been made in the Presidential address to the tendency to take an order first and to cost afterwards. The only salvation of the foundry industry, however, was to cost first and to accept the order afterwards. It was only by such means that the industry could be developed on a profitable basis, so that founders would receive a just return for their efforts, having regard to the skill which they had to apply.

Vocational Representation.

Mr. V. C. Faulkner (Past-President) suggested that, instead of dividing the country territorially and allocating particular territories to particular representatives, as appeared to be the practice of many large firms, it would be preferable, although it might involve a little more travelling expense, to appoint representatives to call upon specified manufacturing industries, no matter in what part of the country the works might be. For example, it would be the duty of one particular representative to call upon manufacturers of cement only, and other representatives to call upon glass, paper, etc.—separately or in combination. Having regard to the close associations of industries, groups of industries could be allocated to the different representatives, and he believed that a more successful approach would be made by organising on those lines rather than allocating different territories to different representatives, which latter system acted very unfairly on many commercial representatives.

The President (Mr. A. Harley) urged the necessity for employing as salesmen people who understood far more about technical production than do many salesmen at present, because very often the designs put forward were expensive to produce, not only because of their complexity, but also because the methods of production must be such that the risks of producing scrap were considerable. If a man who interviewed a customer, in the first place, was able to analyse a design in a practical manner and point out where it was defective, from the point of view of production, he believed alterations would be made which would be such as to enable the founder not only to quote a lower price than he would do otherwise but also to increase the percentage of good castings made. He imagined that salesmen, who knew nothing about designs, very often accepted orders for the production of which their foundries were not suitable. Of course, the decision to refuse or accept an order must remain with those in charge of the foundries, but if an order were accepted, and if it were decided afterwards that the work could not be undertaken, a bad impression was created. The subject was of vital importance, and he regretted that time did not permit of a full and free discussion. At the same time, the valuable information and suggestions contained in the Paper would be studied very closely.

Author's Reply.

Mr. Simons, replying to the discussion, said it was obvious that in a short Paper it was impossible to cover the whole field of merchandising. He agreed that it was absolutely essential that there should be co-operation in every respect between the cost accountant and the sales manager. There had been far too great a tendency to put the sales organisation into a watertight compartment, and to tell the head of the sales organisation, when he wanted to know what things cost and how they were made, that that was not his concern. In any well-organised selling department there must be absolute freedom to inquire into anything which was likely to affect the sales of castings, and the cost accountant was one of the first who should collaborate with the sales manager.

The point raised by Mr. Faulkner—geographical allocation as compared with selling by industries—was very important. The word "territories," as used in the Paper, was used in the broad sense, to apply geographically or to industrial groups. In many cases it was the practice for representatives to cover specified geographical territories, probably because that was the simplest arrangement from a good many points of view. Messrs. Edgar Allen & Company did not apply that system entirely, however. It had representatives who covered specified areas in Great Britain, but there were also engineers and expert demonstrators who concentrated on particular industries. An engineer, for example, called on quarries only, and acted very much as a technical adviser; another concentrated on cement manufacturers and another upon the automobile industry. The geographical areas were allocated to the general representatives. The range of products of his company was so wide that it was impossible for any one man to be an expert in regard to all of them. Consequently, it was necessary to employ general representatives, who might be quite competent engineers, nevertheless. They kept in touch with the markets and effected introductions; when they had effected introductions and indicated to the departments concerned where the markets were, the shock troops, *i.e.*, the expert advisers and demonstrators, came into the field. Their operations were not confined to definite areas, and they did precisely what the President had suggested, *i.e.*, criticised designs, offered advice, etc. Broadly speaking, in the majority of cases there was no charge for these men's services. In the Paper he had emphasised that representatives should be able to do something other than take their customers to public-houses and stand them drinks; the time when such procedure was effective was passing. His firm had found that it was essential for most of the representatives to be men of the works-trained type, who had been employed in the drawing office and works and knew what they were talking about; that was one of the bones he had thrown down in the Paper, in the hope that some dogs would quarrel about it. There had not been so many quarrels as he would have liked, and he assumed, therefore, that, in the opinion of the meeting, he had spoken ordinary common sense.

A New Method of Case-Hardening in an Electric Furnace.

A new method of carburising has been introduced in America by The Hevi Duty Electric Company, whose European Patent rights are controlled by Wild-Barfield Electric Furnaces, Limited, and G.W.B. Electric Furnaces, Limited, respectively. Numerous plants have already been installed by leading firms, and a short description of the process will doubtless be of interest.

The charge to be treated is loaded in a basket, and, although no special attempt is made to keep the components of the charge from touching each other, they should be so placed as to allow the circulation of the carburising medium to take place throughout the charge. In this way maximum uniformity in penetration and structure is obtained. The loaded basket sits inside a heat-resisting-alloy retort inside the furnace chamber. In place of a basket, plates suspended on a vertical rod can be used for bevel and other gears, and camshafts are suspended inside the retort. The retort is fitted with a special cover, which makes a sealed working chamber. A motor-operated Patent paddle fan, incorporated

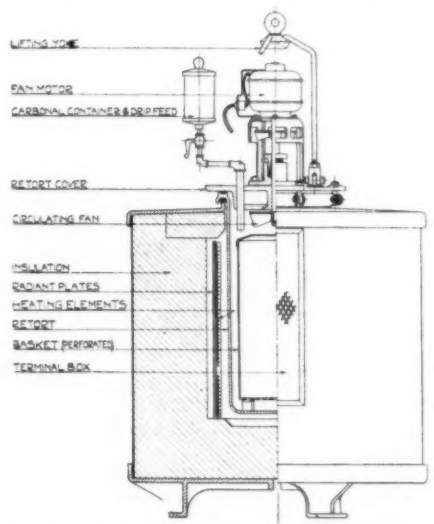


Fig. 1.—The Carbonal Carburising Furnace.

in the cover, circulates the carburising gases throughout the charge. The furnace is shown in Fig. 1.

The furnace and charge are brought up to heat with the fan running, which gives a rapid and uniform rise to the carburising temperature

(*Concluded on page* 42.)

The Effect of Molybdenum and Titanium upon Grey Cast Iron.

Some experimental data concerning the effect of molybdenum and titanium upon the mechanical properties and the structure of cast iron have been given by J. H. Küster and C. Pfannenschmidt in "Die Giesserei," 1931, No. 3. Hematite pig-iron containing 2.6 per cent. of silicon was melted in the cupola together with 20 per cent. of steel scrap. The molten iron was transferred into a Héroult electric furnace and superheated for 35 min. after some ferro-silicon had been added. Then a series of four test-bars was cast at 1,380 deg. C. After

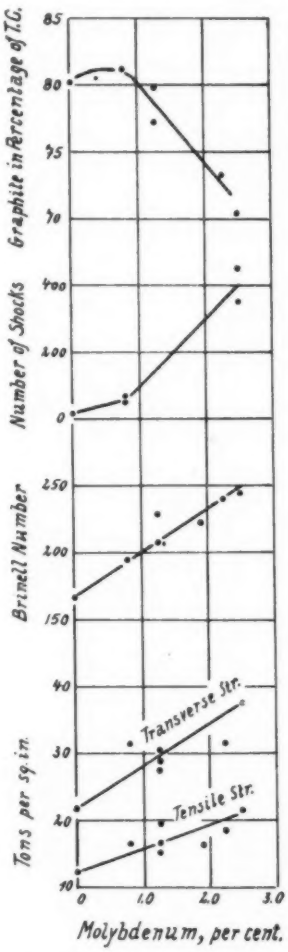


FIG. 1.—SHOWING EFFECT OF INCREASING MOLYBDENUM CONTENT.

part of the molybdenum had been added to the melt, another series of test-bars was cast, and a third series after a further quantity of molybdenum had been added.

The tensile strength, transverse strength, Brinell hardness, resistance to shock, and the microstructure were examined. The broken test-bars were remelted in an oil-fired furnace, further quantities of molybdenum added, and four other series of test-bars cast to complete the experimental results. Apart from the molybdenum content, the composition of the test-bars was as follows:—T.C., about 3.4; Si, 2.5; Mn, 0.4; S, 0.05 and P, 0.15 per cent. The experimental results illustrated in Fig. 1 show that the strength properties increased with increasing molybdenum content. An effect upon the graphite content was only noticeable when the molybdenum content was over 1 per cent. With the higher percentages a remarkable refinement of the graphite flakes could be seen under the microscope.

The titanium was alloyed to an iron containing a rather high manganese content for the purpose of rendering it more easily machinable. As alloying element a ferro-titanium was used, containing 16 per cent. of titanium and about 7 per cent. of carbon. The heats were made in a coke-fired crucible furnace. A quantity of ferro-titanium, corresponding to 0.5 per cent. of titanium in the mixture, was placed on the bottom of the crucible, thereon the broken pigs and returned scrap, and the crucible was firmly closed by a cover. Tensile and transverse tests were made, the results being illustrated in Fig. 2. The numbers in the graph indicate the manganese content, those placed in brackets the titanium content. Besides the alloying elements given in the graph, the samples contained T.C. 3.3 to 3.6, S about 0.05, and P about 0.25 per cent. The test results show that the addition of titanium resulted in a remarkable increase in transverse strength, especially with the low-silicon irons. An increase in tensile strength could only be stated with two irons. Further, the titanium reduced the manganese content by

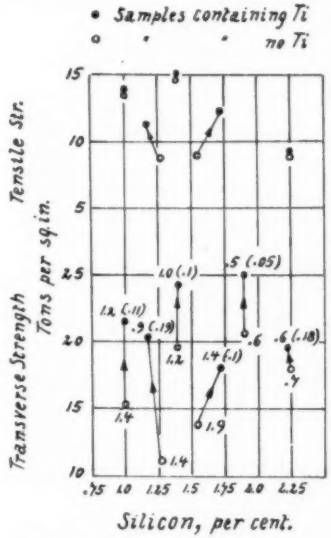


FIG. 2.—RESULTS OF TENSILE AND TRANSVERSE TESTS.

facilitating the segregation of manganese sulphide. With one iron a coagulation of the MnS could be seen under the microscope. Titanium had no appreciable effect upon the graphite content; it reduced, however, the particle size of graphite and the depth of chill. Abrasive tests showed that the irons containing titanium had a much higher resistance to wear than had the other samples.

Publication Received.

X-Rays and Industry.—This highly-interesting brochure, received from the Eastman Kodak Company, Rochester, New York, gives a simple but instructive review of the theory of radiography and various apparatus in connection with the subject.

Of more interest to the founder, however, is the industrial application of the X-rays, which, the author states, provides a most efficient means of examining the internal structure of castings, while he emphasises their use in the inspection of sample castings, and in castings requiring expensive machine labour.

The brochure contains several examples illustrating the value of X-ray examinations, accompanied by some excellent photographs, and forms an interesting booklet, which should be of real use to all founders making to specified requirements.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

The Structure of the British Foundry Industry.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—Having read the extract from the Paper* given by Mr. Vincent C. Faulkner to the American Foundrymen's Association, in which he states he is not aware of any castings (steel) being made by the acid-lined electric furnace, we wish to inform him there is an acid-lined electric furnace in Birmingham which has been making steel castings for over two years. The bottom, linings and roof have done exceedingly well, and if of interest to Mr. Faulkner or readers, the writer could obtain the furnace records. In addition, there is another similar plant in Scotland, having been running on acid bottom for a longer period than the Birmingham furnace.

There are no British sands that can be used without some adulteration or mixing of other sands for steel castings; the only British sands available for making steel castings are synthetic sands or mixtures of clay and silica sand, and if there are any founders interested in synthetic sands and mixtures for the production of dry- or green-sand steel castings, the writer will be only too pleased to assist them, being one of the pioneers in this class of work.

In passing, I must say I thoroughly enjoyed the reading of this extract, because of its wide and general nature, and I hope it will soon be followed by another on similar lines.—Yours, etc.,

DONALD PITT.

53, Solihull Lane,
Hall Green,
Birmingham,
July 6, 1931.

[We thank Mr. Pitt for his observations, and would welcome the operating details of the acid-lined furnaces. At one time, there was quite a number in operation in Great Britain. If our memory serves us correctly, we remember seeing plants in operation at Leven (Scotland), Bradford (Yorks), Barnsley and Darlington. It should be remembered that the Paper, of which we published but a short abstract, covered practically every phase of the foundry industry, but presuming that the commercial and technical, research and kindred activities were well known to our readers, we deleted them from the abstract.—EDITOR.]

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—I note that in your Paper on the British Foundry Industry, published in the Transactions of the American Foundrymen's Association for June, 1931, you say that the high-frequency induction furnace is being used in one southern foundry (Lake & Elliot) for the manufacture of steel castings.

A similar high-frequency induction furnace (Metro-Vickers, 500 lbs.) is also used very successfully at the Vickers works of the English Steel Corporation, for the manufacture of stainless, heat-resisting, magnet and other types of steel castings. Edgar Allen also use their high-frequency induction furnace for the manufacture of steel castings.

In the coming session's programme for the Sheffield Branch, I am trying to arrange for a Paper on the use of the high-frequency induction furnace for the production of steel castings.—Yours, etc.,

T. R. WALKER,
Hon. Secretary, Sheffield Section of the Institute of British Foundrymen.

33, Ladysmith Avenue,
Nether Edge.
July 7, 1931.

* A short abstract of this appeared in our issue of July 2.

The Foundries of Messrs. Alfred Herbert, Limited.

So far as Great Britain is concerned, all machine-tool foundries must be classified as "jobbing," for, even with the immense resources of Messrs. Alfred Herbert, Limited, of Coventry, a highly-mechanised installation would not be an economic proposition. What they have accomplished can be summarised in the following short statement:—(1) They have assured for themselves the regular production of the highest class of casting for their particular line of manufacture; (2) have segregated into separate foundries the heavy and light castings; (3) have largely eliminated hand moulding by substituting jar-squeeze machines, and (4) mechanised the production of certain of the larger castings within a "unit" system.

Lay-Out.

The general lay-out of the two foundries is shown in Fig. 1, from which it will be seen that there is a proper flow of material through the foundries, with little chance of congestion.

All raw materials, pig-iron, sand and fuel are analysed and graded before permission to use them is given. The chemical laboratory, which is shown in Fig. 2, is particularly well equipped, lighted and ventilated. In the same group of buildings, a mechanical-testing laboratory controls the properties of the semi-finished and final productions of the firm. It is equipped with both large and small Avery tensile-testing machines, an Izod impact tester, a number of standard and modified Brinell hardness testers and a Rockwell apparatus. With its complement of lathes, saws, drills and heat-treating furnaces, this department and its associated laboratories would fully satisfy the desires of the most ardent advocate of "science in the foundry."

Pattern Shop.

This includes the whole of the wood-working departments of the works. It is so fully equipped that it now ranks amongst the best in the land. The principal machine is a Wadkin Universal Woodwork, to which machine-constructor has also been confided the provision of planers, shapers, etc. At the moment the final touches are being given to this shop by the installation of individual drives. Here, as in a number of Midland pattern shops, there is no sand-papering machine, as the foreman is of opinion that such machines warrant the label—the poor patternmaker's friend.

For the large jar-ram squeeze machine, to be dealt with later, the pattern boards are made from multi-ply wood. Naturally, the shop has a full complement of lathes, drills, saw-sharpening machines, bandsaws and the like. The shop, as will be seen from Fig. 3, is well lighted and ventilated, whilst all the machines are particularly well guarded. To digress a moment, this work of making the shops fool-proof has received special attention by the management, and it is pleasing to see that all piping is coloured according to its contents; thus gas pipes are green, compressed-air blue and the sprinkler system red. All the overhead cranes are red because they can be a source of danger to the forgetful workman. Then notice has been taken of places where air becomes stale and foul, and at these points either natural or mechanical ventilation has been provided. Obviously, the mentality of such a management would never permit any form of untidiness, and from this angle the works of Alfred Herbert rank amongst the neatest and cleanest in Great Britain.

Raw Materials.

The pig-iron is stocked in the yard shown in Fig. 4. Here the charges are loaded into wheeled bogies and sent up by hoist to the cupola-charging stages, the route being indicated in Fig. 1.

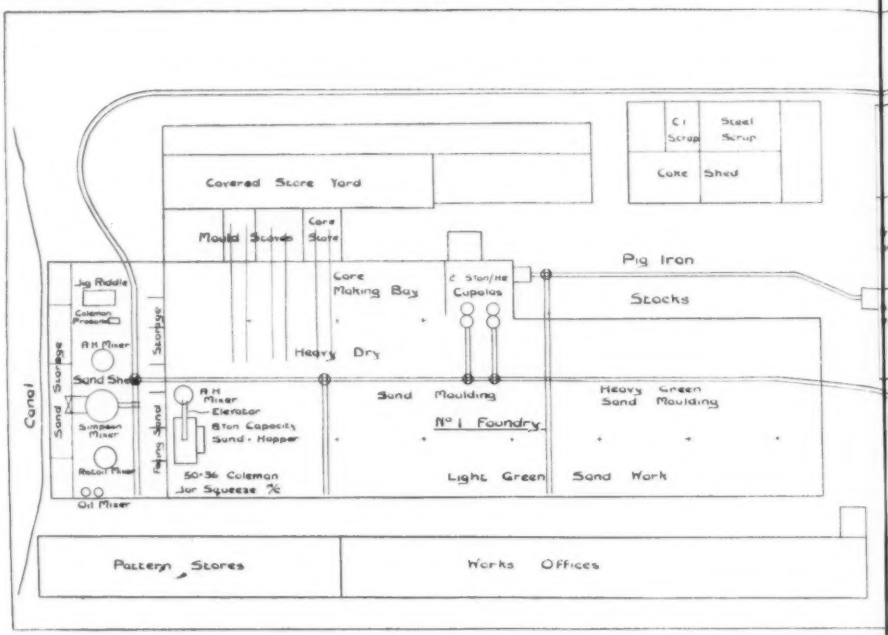


FIG. 1.—GENERAL LAY-OUT OF THE FOUNDRIES OF AL

A unique feature is the use of turnings and borings from their own machine shops, which are hand-rammed into spot-welded, loose-ended canisters. The loss, which has been ascertained by individual experiment and continuous experience, shows it to be little greater than with small scrap, 8 per cent. being an outside figure. On arrival at the cupola stage all materials are carefully weighed before charging.

Sand Preparation.

Sand is brought to the foundry by canal. It is treated in a segregated department (shown in Fig. 5), which is equipped with an August-Simp-

FIG. 2.—THE CHEMICAL LABORATORY.

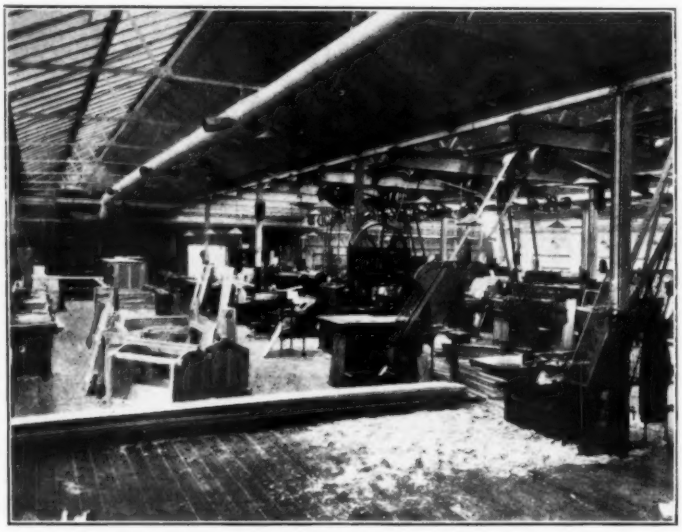
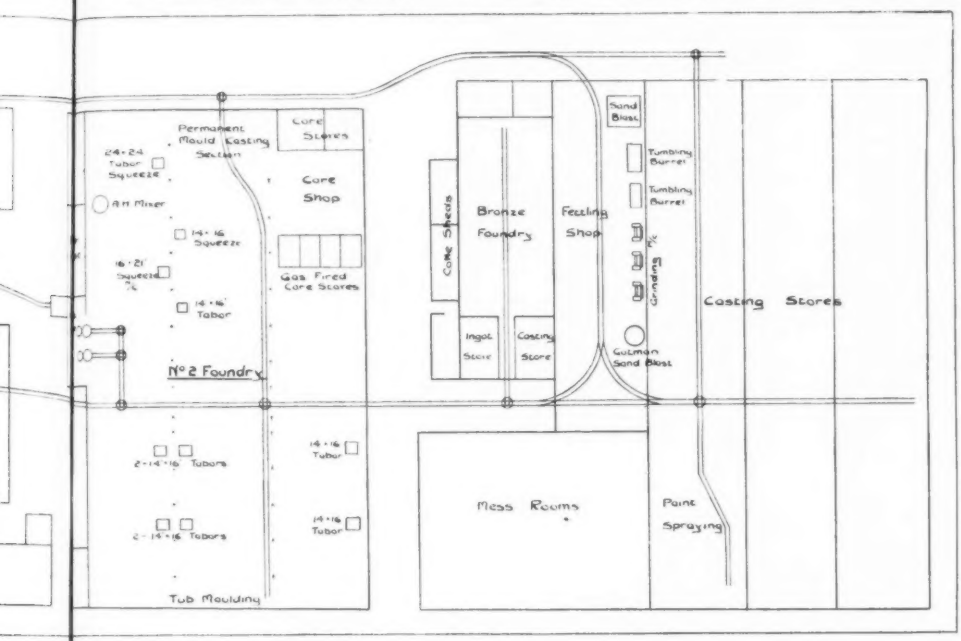


FIG. 3.—THE PATTERN SHOP.

son intensive mixer of the bucket-loading type, which permits of direct discharge into bogies for transport to either of the foundries by crane or rail, no barrows being used.

Before the sand is milled it is passed through a Herbert disintegrator, and it is interesting to note that this excellent machine is now being re-designed to give a one-place delivery, so that it can be better incorporated into continuous

Unlike many installations of this character, the machine is not marred by the lack of auxiliary plant, and it is surmounted by a hopper and valve-controlled shute. The hopper will hold about 8 tons of sand, and is filled by a bucket-elevator from a pit. This pit receives its supply of sand from the base of a Herbert centrifugal disintegrator, this machine being surmounted by a screen to eliminate foreign matter.



FOUNDRY OF ALFRED HERBERT, LIMITED, COVENTRY.

sand-mixing plants. For the preparation of the oil-core sand mixtures, a Rotoil machine is used.

The Heavy Foundry.

In one corner of this section there is an exceedingly interesting lay-out for the manufacture of headstocks, turret slides, ball-bearing drill

The half-moulds are baked overnight in a twin coke-fired stove having compartments measuring 22 ft. by 15 ft. by 12 ft. high. In the morning they are cored up, closed and cast. The castings are stripped and sent forward to the fettling shop, whilst the boxes are emptied by a compressed-air-operated vibrator. Then the sand,

Acme (Foundry & Engineering Company) stove. There are two compartments about 10 ft. by 8 ft., which take skeleton trolleys mounted on rails. The Acme furnace is of the forced-draft type, and the ovens served are shown in Fig. 7.

In the general view of the heavy foundry, Fig. 8, the cupolas are shown on the left. They are No. 5 Thwaites Rapid furnaces, furnished with receivers. This plant is duplicated in the light foundry; the blast, however, is furnished from a Roots' blower in the latter case and is Sturtevant-fan-driven in the former.

The metal, moulds and mould-boxes are handled by three 5-ton overhead electric travelling cranes by S. H. Heyward & Company and Craven Bros., and four 2-ton cranes by Morris. Additionally, jib cranes are provided for local handling.

The Light Iron Foundry.

The melting plant is similar to that installed in the heavy foundry. It can just be seen in Fig. 9 at the left-hand side. Virtually, all the moulding is carried out in green sand on Tabor machines, of which there are ten in operation. The largest has a 24-in. square table, whilst there are eight with a 14-in. by 16-in. table. A machine with a 16-in. by 21-in. table completes the series. Herbert sand-mixers are used for reconditioning the backing sand. A speciality of this foundry is the manufacture of iron bars of various diameters in chills, a process developed and described by the late Mr. Edward Broughal.

The handling of materials is effected by two 2-ton Morris cranes and an electric block by Vaughan. Cores are dried in four gas-fired Britannia stoves which have the temperatures controlled at 250 to 300 deg. C.

A small self-contained brass and bronze foundry, using pit fires for melting, is engaged upon routine work for machine parts and works maintenance. A special plant has been devised for the making of tinsmiths' and coppersmiths' hammers, using chills as moulds.

The Fettling Shop.

This is equipped with a Tilghman sand-blast chamber, a Gutmann sand-blast barrel, ordinary tumbling barrels, pneumatic chippers and double-ended grinders. All castings, after painting with an air-brush, are put into stock. We were in-

FIG. 4.—THE PIG-IRON STOCK YARD.

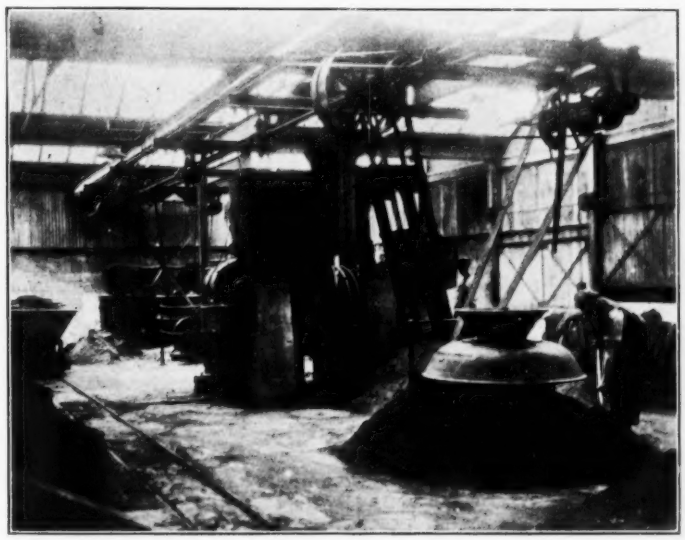


FIG. 5.—THE SAND-PREPARING DEPARTMENT.

columns and tables, large covers and the like. Moulds are made on the largest jar-ram-squeeze machine (Fig. 6) ever installed in a British foundry. Designed by Coleman Foundry Equipment, it carries a 50-in. by 36-in. table. It weighs 14 tons, is provided with a 24-in. draw, and is capable of lifting 20 tons.

as stated, passes through the Herbert mixer adapted to feed the boot of the elevator, where an impeller throws the material across the hopper situated immediately above the Coleman machine, giving a complete and easy cycle of work. The cores for this and loose-pattern moulding in the heavy foundry are dried in an

formed that the normal tensile strength of the iron used for their grey-iron castings is of the order of 18 tons per sq. in.

In conclusion, we acknowledge with gratitude the help given us by Mr. E. M. Currie in the preparation of this article.

(*See also overleaf.*)

The Foundries of Messrs. Alfred Herbert, Limited.

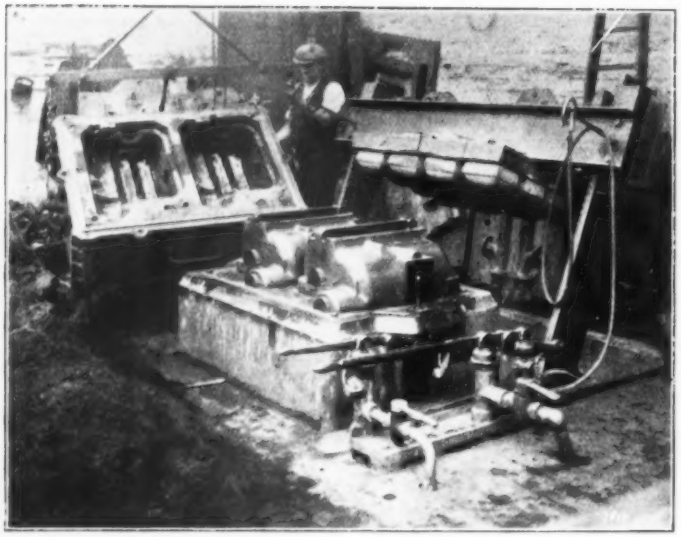


Fig. 6.—Jar-Ram-Squeeze Moulding Machine, by Coleman Foundry Equipment Company—the Largest installed in a British Foundry.

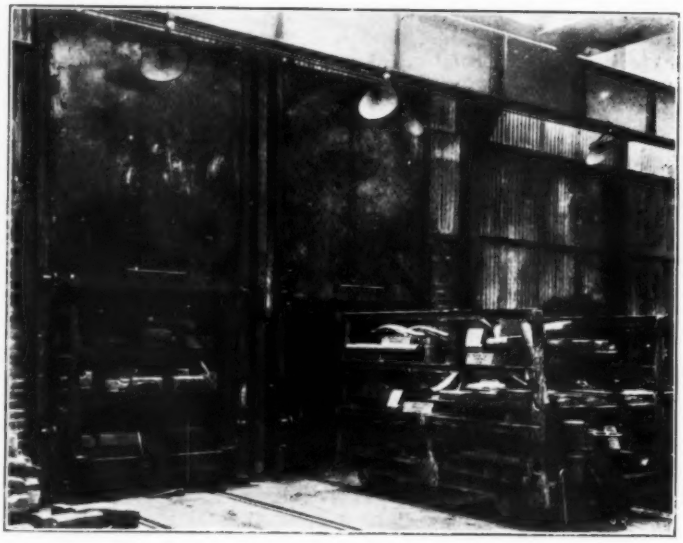


Fig. 7.—Mould- and Core-Drying Ovens.

Fig. 8.—General View of the Heavy Foundry.

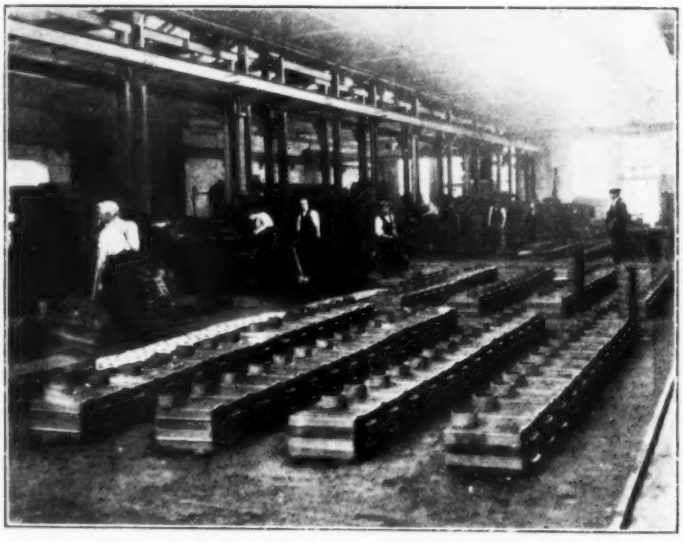


Fig. 9.—General View of the Light Iron Foundry.

A New Method of Case-Hardening in an Electric Furnace.

(*Concluded from page* 38.)

of about 940 deg. C., this temperature depending upon the type of steel used and the kind of case-structure required. The Carbonal is then introduced into the hot retort by means of a drip-feed attachment mounted on the retort cover.

The Carbonal, which is made up of a vegetable base, very rich in hydrocarbons, on entering the retort is forced outward against the hot walls by the centrifugal action of the circulating fan, where it is immediately cracked up into hydrocarbon gases, which circulate through the charge, thus exposing it to a very active carburising agent. The forced circulation assures fresh uniform gas being brought to the work continuously.

Carburising proceeds very rapidly. A penetration of from 12 to 15 thousandths of an in. at 930 deg. C. takes place per hour. After the carburising cycle is complete, the retort is lifted out of the furnace by an overhead gear and cooled in the air, while a second loaded retort is placed in the furnace. In some cases the carburised work is quenched from or a little under the carburising temperature, this being accomplished by removing the cover and handling the charge direct to the quench, by means of the basket containing the charge. The production costs are based on a typical furnace having an inner basket dimension of 18 in. dia. by 42 in. deep, accommodating a charge of work weighing 1,000 lbs.

Current Consumption.

A furnace of the above size has a fixed input of 75 kw. With this input it would be possible to bring the total gross charge up to carburising temperature in 3 hours. During this period approximately from 200 to 225 kw.-h. would be consumed. The amount of consumption is less than the full input of the furnace at 3 hrs., because the chamber will come up to temperature more rapidly than the centre of the charge, which means that the furnace will go on control before the charge is saturated. Three hours, however, would be a fair estimated time for this.

Radiation losses will be 15 kw. at carburising temperature. For a case depth of $\frac{1}{16}$ in. the normal carburising time is 4 hrs., resulting in power consumption of 60 kw.-h. The total current consumption for the whole cycle (lasting 7 hrs.) would be approximately 285 to 300 kw.-h., or a production rate of 3.33 lbs. per kw.-h.

Where it is possible, a lower production cost can be obtained by loading a spare retort into the hot furnace, and still further reduction can be made if the work can be quenched from the basket, and the already hot retort loaded and replaced in the furnace without losing much of its heat. Under these conditions, weights as high as 5 to 5.6 lbs. per kw.-h. can be obtained.

For case depths of $\frac{1}{8}$ in. and $\frac{3}{16}$ in., the respective carburising times are 8 and 15 hrs. Consumption of Carbonal for the foregoing operation is about 1 pint per hr., and the cost of Carbonal is about 8½d. per pint.

Alloys for Use at High Temperatures.*

EFFECT OF COMPOSITION AND EXPOSURE TO HIGH TEMPERATURES.

By C. H. M. Jenkins, D.Sc., A.R.S.M., and H. J. Tapsell, A.C.G.I., A.M.I.Mech.E.

(Abridged.)

The present work forms a continuation of two previous Papers on nickel-chromium and complex iron-nickel-chromium alloys, Part I, by Dr. W. Rosenhain, F.R.S., and one of the present authors, and Part II by the present authors and others.

Certain sections of the two Papers referred to above deal with the strength under prolonged loading of a few complex chill-cast nickel-chromium-iron alloys, and it is shown in the case of two alloys not greatly dissimilar in composition, except for their carbon and silicon contents, that marked differences exist in the mechanical properties (resistance to creep, tensile strength, etc.) under similar testing conditions. These differences suggest that the improvement of one alloy by the addition of proportions of carbon and silicon is worthy of further study, as it is likely that the information thus gained may be applied at a later date to the improvement of valuable high-temperature properties of other series of alloys.

The compositions and properties of the two alloys previously examined are set forth below so that their behaviour can be readily compared. The test specimens for the short-time tensile tests (Table I) and the long-duration tests (Table II) were obtained from a riser 1.5 in. dia. from a casting weighing 25 to 30 lbs. Chemical analyses, alloy No. 139 (alloy No. 183): Nickel, 30.35 (30.15); chromium, 28.85 (28.55); tungsten, 3.96 (3.79); carbon, 0.55 (1.34); silicon, nil (1.05); iron, 35.84 (35.00); total, 99.55 (99.88) per cent.

A consideration of the results obtained by testing the sand-cast alloy No. 183 confirms the statement made in the previous Papers that the results for sand-cast alloys are not below those for the chill-cast material. It will also be noticed that the data derived from the tensile tests described in the present Paper confirm the importance of a high ratio between the short-time tensile test at 800 deg. C. and that at atmospheric temperature, provided the short-time tensile strength at 800 deg. C. is high.

The tests given in Tables I and II show that an increase of the carbon content from 0.5 to 1.5 per cent., together with a silicon addition of 1 per cent., has brought about a marked improvement in the properties of this type of alloy. During the course of previous prolonged-stress tests at 800 deg. C. it was noticed that changes in hardness and in microstructure took place. In the present investigation these effects are also more fully traced.

TABLE I.—*Short-Time Tensile Tests on Alloys Nos.* 139 *and* 183.

	Alloy no. 139.				Alloy no. 183.			
	Rolled.		Chill-cast.		Chill-cast.		Sand-cast.	
	Tensile strength. Tons per sq. in.	Elongation. Per cent.	Tensile strength. Tons per sq. in.	Elongation. Per cent.	Tensile strength. Tons per sq. in.	Elongation. Per cent.	Tensile strength. Tons per sq. in.	Elongation. Per cent.
At atmospheric temp. ..	66.5	12	31.0	2	48.4	2	—	—
At 650 deg. C.	38.3	12	21.7	3	—	—	—	—
At 800 deg. C.	18.7	45	20.1	3.5	30.6	4.5	26.8	3.5
Ratio of tensile strength at 800 deg. C. to that at atm. temp.	0.28	—	0.64	—	0.63	—	—	—

Present Research.

The objects of the present work are set out and dealt with in the following three sections:

Section I.—To determine the effect of additions of carbon and silicon to a cast nickel-chromium-iron-tungsten alloy, which appears to possess favourable resistance to creep at 880 deg. C. The behaviour was examined by mechanical tests and microscopic examination. Section II.—To determine the effect of exposure of such alloys to a service temperature of 80 deg. C., by means of microscopic examination, Brinell-hardness measurements and tensile tests. A series of tests to investigate the effects of exposure for a constant period at temperatures between 600 deg. and 1,100 deg. C. was also carried out. Section III.—To account for the phenomena met with in Sections I and II. To some extent the resistance to flow under prolonged load and the age-hardening changes which occur at the service temperature under consideration appear to be interrelated.

TABLE II.—*Long-Duration Tensile Tests at* 800 *deg. C. on Alloys Nos.* 139 *and* 183.

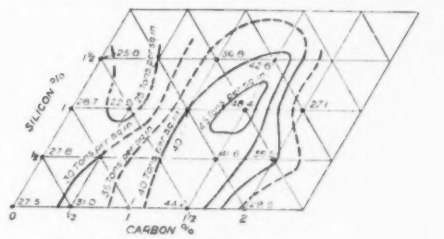
Life in days for failure to occur.	Stress in tons per sq. in.						
	8	6	5	4	3.2	2.8	2.4
No. 139, rolled	—	—	—	—	1–1½ [20]	2½ [31]	4 [35]
No. 139, chill-cast	—	—	7½ Flaw	12½ Flaw	45 Unbroken	—	—
No. 183, chill-cast	15½ [2]	50½ Flaw	68 Unbroken	—	—	—	—
No. 183, sand-cast	15 [3]	—	—	—	—	—	—

Figures in square brackets denote percentage elongation.

Alloys Used in the Present Investigation.

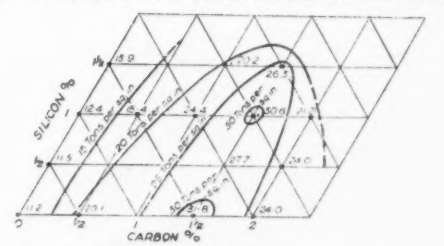
On account of the hardness of some of the alloys, tests were not carried out on the series in the forged or rolled condition. A comparable series of alloys in the chill-cast condition was, however, studied in view of the high creep-resistance of this type of material. For the tensile tests, bars 1 in. dia. were cast, but larger bars 1 $\frac{5}{16}$ in. dia. were prepared for hardness tests and heat-treatment prior to microscopic examination.

For the work described in Section I, fifteen alloys of different compositions in regard to silicon and carbon were cast. The carbon contents of these materials range from 0 to 2.0 per cent., and the silicon contents from 0 to 1.5 per cent. From the results of the tests in Section I, eight alloy compositions were selected for the exposure tests at 800 deg. C. described in Section II. From these eight compositions, five alloys with characteristic properties were selected for the further tests under Section II and were exposed to various temperatures between 600 deg. and 1,100 deg. C. for a uniform period of 4 days. For the final series of tests described in Section II, on the properties of material which had received preliminary heat-treatment to effect hardening before testing, three typical compositions were chosen.



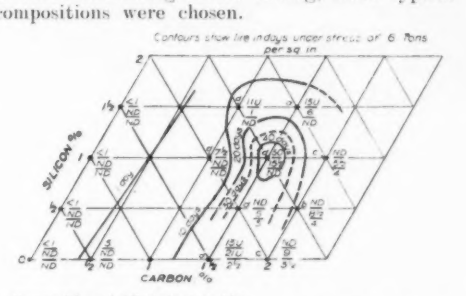
Composition of Alloys (per cent.): Nickel 30; Chromium 30; Tungsten 4; Iron + Silicon + Carbon 36.

FIG. 1.—TENSILE STRENGTH (SHORT-TIME TESTS) AT ATMOSPHERIC TEMPERATURE.



Composition of Alloys (per cent.): Nickel 30; Chromium 30; Tungsten 4; Iron + Silicon + Carbon 36.

FIG. 2.—TENSILE STRENGTH (SHORT-TIME TESTS) AT 800 DEG. C.



Composition of Alloys (per cent.): Nickel 30; Chromium 30; Tungsten 4; Iron + Silicon + Carbon 36.

The proportion of primary constituent *C* is indicated thus: *(a)* Small proportion; *(b)* intermediate between *a* and *c*; *(c)* considerable proportion; *(d)* trace or absent.

The top, middle and lower figures against each composition represent the life in days under stresses of 6, 8, and 10 tons per sq. in., respectively. U. = Unbroken; N.D. = Not determined

FIG. 3.—RESULTS OF PROLONGED-STRESS TESTS AT 800 DEG. C.

Properties of Chill-Cast Alloys.

The chemical composition of the alloys and the results of the mechanical tests on the chill-cast specimens are contained in Tables III and IV. The tensile strengths of the alloys at room temperature are also set forth in Fig. 1, the results of short-time tensile tests at 800 deg. C. are shown in Fig. 2, while the results of the prolonged-stress tests at 800 deg. C. are plotted in Fig. 3.

* Paper read before the Annual Meeting of the Iron and Steel Institute in London.

From a consideration of the tensile strengths of the various alloys, as shown in Fig. 1, it seems that additions of silicon do not bring about any marked change in the properties of the alloys, whereas additions of 0.5 per cent. of carbon cause a slight hardening, and an addition of 1.0 per cent. of carbon produces a great improvement in strength. The alloys which exhibit the greatest strength contain 1.5 per cent. of carbon, but the addition of 2.0 per cent. causes the properties to show a marked falling-off.

The relationship between strength under short-duration tests at 800 deg. C. and carbon content (Fig. 2) follows broadly the lines indicated for the cold tensile tests in Fig. 1. The alloys containing 0.5 per cent. of carbon possibly show a greater increase of strength over the carbonless alloys than is indicated in the corresponding tests at atmospheric temperature. Two of the alloys containing 1.5 per cent. of carbon show at 800 deg. C. a tensile strength in excess of 30 tons per sq. in., whereas those containing only 1.0 or as much as 2.0 per cent. of carbon do not possess a strength of 25.0 tons per sq. in.

A consideration of the elongations obtained in the course of these tests is important. The alloys to which no carbon addition had been made are found on testing at atmospheric temperature to extend as much as 18 to 28 per cent. in the chill-cast state, even if the silicon content is as high as 1.5 per cent., but the alloys which contain 0.5 per cent. or more of carbon do not extend by more than 3 per cent. The results of the tests at 800 deg. C. are somewhat different. The carbonless alloys, although exhibiting greater ductility than those containing carbon, do not show one-half the amount of the ductility of the alloys tested at atmospheric temperature. The ductility of the carbon-bearing alloys has, however, increased; in some cases the elongation is from two to three times as great at 800 deg. C. as in the tests made at atmospheric temperature.

The results of the prolonged-stress tests, in all cases made at 800 deg. C. (Fig. 3), show, even more strikingly than the short-duration tests, the effect of additions of carbon to the alloys. This graphical record has been contoured at various intervals to indicate the probable times during which a specimen will sustain a load of 6 tons per sq. in. before rupture occurs. In view of the marked differences in the strength of the alloys, testing could not be carried out at a uniform stress intensity. To obtain results within a reasonable period of time, testing was carried out at several stresses, three of which have been recorded in Fig. 3. The life of the test specimen before rupture occurs is given on the diagram in the three figures, the uppermost figure being the life at 6 tons per sq. in., the intermediate figure at 8 tons per sq. in., and the lowest one at a stress of 10 tons per sq. in.

In the case of the prolonged-stress tests, additions of silicon do not greatly affect the strength of the alloys, but in the case of alloys containing 1.5 per cent. of carbon this proportion of the element appears to improve the alloy in regard to stability in a manner referred to later, but which is not distinctly shown in the results of these mechanical tests. Although the effect of the addition of 0.5 and 1.0 per cent. of carbon is to bring about a marked improvement in the properties of the alloys, it is not so striking as the change produced by an addition of 1.5 per cent. The high values for the strength of these alloys are not sustained if the carbon content is increased to 2.0 per cent. The maximum resistance to stress appears to occur in the alloy containing 1.5 per cent. of carbon and 1 per cent. of silicon. A test on this alloy was in progress for 309 days at 3.0 tons per sq. in. at 800 deg. C. The specimen then had extended 1 per cent. of its length. The test is being continued. This compares very favourably with some previous tests on alloy *M*, which fractured after 152 days at a stress of 2.8 tons per sq. in. at 800 deg. C. This material, described as a heat-resisting steel, is a forged commercial alloy, one sample of which had the following composition (per cent.): Nickel, 26.5; chromium, 14.0; tungsten, 3.6; iron, 53.0; manganese, 1.0; carbon, 0.5; silicon, 1.2.

TABLE III.—*Composition of Complex Nickel-Chromium-Iron Alloys.*

Alloy No.	No. of Corresponding Bar in— Micro. Exam. and Hardness Tests.	No. of Corresponding Bar in— Tests on Heat-Treated Material.	Nominal— C. %	Nominal— Si. %	Chemical Analysis. C. %	Si. %	Ni. %	Cr. %	Fe. %	W. %
265	289	...	0	0	0·05	0·13	29·83	29·63	36·06	3·64
266	...	...		0·5	0·04	0·65	30·0[1]	30·0[1]	35·5[1]	4·0
264	290	298	0	1·0	0·03	1·11	30·0[1]	30·0[1]	35·0	4·0
267	...	...		1·5	0·04	1·53	30·0[1]	30·0[1]	34·5[1]	4·0
137	291	299	0·5	0	0·55	...	30·35	28·85	35·84	3·96
268	...	...		1·0	0·59	1·11	30·0[1]	30·0[1]	34·5[1]	4·0[1]
269	294	...	1·0	1·0	1·03	1·13	30·0[1]	30·0[1]	34·0[1]	4·0[1]
276	...	...		1·5	0·92	1·60	29·96	28·88	34·02	3·92
271	292	...	1·5	0	1·54	...	29·88	29·6	35·70	3·22
275	293	...		0·5	1·43	0·62	29·74	29·7	34·72	3·55
183	288	297		1·0	1·34	1·05	30·15	28·55	35·00	3·79
270	...	...		1·5	1·59	1·51	30·0[1]	30·0[1]	33·0[1]	4·0[1]
274	...	...	2·0	0	1·97	0·09	30·0[1]	30·0[1]	33·5	4·0[1]
277	...	...		0·5	1·70	0·68	30·0[1]	30·0[1]	33·5[1]	4·0[1]
278	295	...		1·0	1·72	1·04	30·0[1]	30·0[1]	33·0[1]	4·0[1]
301	...	...	1·5	1·0	1·5[1]	1·0[1]	30·0[1]	30·0[1]	37·5[1]	Nil

[1] Intended composition. In all alloys, with the exception of No. 301, which has no addition of tungsten, the materials were added to the charge in the following proportions: Nickel 30; Chromium 30; Tungsten 4; Iron + Carbon + Silicon 36 per cent.

TABLE IV.—*Mechanical Properties of Complex Nickel-Chromium-Iron Alloys.*
(*Results of tests on 1-in. dia. chill-cast bars, untreated.*)

Alloy No.	Short-Time Tensile Tests. At Air Temperature. Yield Stress. Tons per sq. in.	Ultimate Stress. Tons per sq. in.	Elongation. %	At 800° C. Yield Stress. Tons per sq. in.	Ultimate Stress. Tons per sq. in.	Elongation. %	Prolonged-Stress Tests at 800° C. Life in Days before Rupture Occurs. Percentage Elongation in Brackets. 10 Tons per sq. in.	8 Tons per sq. in.	6 Tons per sq. in.	5 Tons per sq. in.	4 Tons per sq. in.	3 Tons per sq. in.
265	13·6	27·5	24	6·3	11·2	10·0	...	...	2–3 hr.	...	< 1	...
266	14·9	27·8	20	6·85	11·5	10·0	...	...	1 hr.	...	6 hr. [3]	...
264	15·6	28·7	28	...	12·4	3·0	...	...	1 hr.	...	Approx. 1	2–5 [4]
267	15·5	25·8	18	7·8	13·9	8·5	...	...	1–2 hr.	...	Approx. 1	...
137	...	31·0	2	...	20·1	3·5	...	...	...	7·5 Flaw	12·5 Flaw	...
268	...	22·9	1	...	15·4	3·0	...	...	At once	...	7·0	...
269	...	40·1	2	...	24·4	2·5	...	...	7·5	17 U.	...	...
276	...	35·7	3	...	20·2	3·0	...	1 [2]	11 [2]	...	...	...
271	...	44·2	1	...	31·8	3·5	2·5 [2·0]	21 U.	13 U.	...	...	...
275	...	40·0	1	...	27·7	5·0	3·0 [1·5]	5 [1]	...	...	...	...
183	...	48·4	2	...	30·6[1]	4·5	...	15½ [2][1]	50½ Flaw	68 U.	...	309 U.[2]
270	...	42·6	2	...	26·3	7·0	...	6	13 U.	...	...	...
274	...	28·5	1	...	24·0	1·5	3·5 [4]	9·0 [3]	...	...	...	...
277	...	36·5	1	...	24·0	3·0	4·0 [3]	8·5 [1·5]	...	...	...	...
278	...	27·1	1	...	21·2	0·5	4·0 [4]	5·5 [1·5]	...	...	...	...
301	...	...	...	...	24·0	3·5	...	...	3–5 [6]	13	...	...

U. = unbroken. Specimen withdrawn from test; no immediate prospect of failure.

[1] On sand-cast material the following results at 800° C. were obtained: Tensile test, 26·8 tons per sq. in.; elongation, 3·5 per cent. Creep test, load 8 tons per sq. in.; endurance 15 days; elongation, 3 per cent.

[2] The test at 3 tons per sq. in. at 800° C. is being continued.

TABLE V.—*Melting Points of Complex Nickel-Chromium-Iron Alloys.*

Alloy No.	Composition— Ni. %	Cr. %	W. %	Fe. %	C. %	Si. %	Mn. %	Conditions under which Determinations were made.	Upper Thermal Arrest on Melting or Freezing. °C.	Lower Thermal Arrest on Melting or Freezing. °C.	Range of Thermal Curve. °C.
183	30·15	28·55	3·79	35·00	1·34	1·05	...	On heating	1314	1289	1400–690
								On cooling	1303	1285	1610–810
265	29·83	29·63	3·64	36·06	0·05	0·13	...	On heating	1370	Not detectable	1475–640
								On cooling	1350		1475–640
..[1]	30·59	29·80	Nil	39·48	...	...	...	On cooling	1406	...	...
...[1]	39·60	28·87	Nil	30·69	...	...	...	On cooling	1400	...	...
M	26·50	14·00	3·59	53·10	0·46	1·20	1·09	On heating	1392	1375	1550–690
								On cooling	1378	1371	1500–640

[1] See "Journal of the Iron and Steel Institute," 1930, No. 1, p. 287, Table XV.

Correlation of Microstructure with the Mechanical Properties.

Effect of Silicon.—Silicon is possibly largely retained in solid solution in the alloys, and the presence of this element in the absence of carbon does not improve the tensile strength of the alloys under either the short-time or prolonged tests.

Effect of Carbon and of Carbon and Silicon.—Carbon appears to have three effects on alloys of this composition. First, it produces a

(*Continued on page* 48.)

The Revolver Core-Making Machine.

The Revolver core-making machine utilises the principle of sending the sand at high speed into a core box by means of compressed-air operating at 60 to 85 lbs. per sq. in. It is specially useful for quantity-production works on account of its high output. Cores of the most intricate character can be produced through this medium.

The general appearance of the machine and the method of working is shown in Figs. 1 to 3. The core box is placed on the table to the left of the magazine *l* (Figs. 2 and 3), so that the inlet of the core box projects about $\frac{3}{16}$ in. over the edge of the table towards the flange *n*. By turning the lever *e*, the table is raised sufficiently to bring the core-box opening to the same height at the nozzle in the flange *n*. The piston of the upper clamping cylinder *s*, situated above the core box, is lowered by a handwheel-actuated screw until its dished end nearly touches the core box. The block *u*, which receives the whole force of the impact, is pushed firmly up to the end of the core box, and secured to the table by the hand lever. When the valve *w* is opened, the piston of the clamping cylinder *s* presses its dished end firmly against the core box and makes its joints airtight. A further turn of the hand lever *x* of controlling valve *w* will cause the lower clamping cylinder *t* to advance against the magazine until the core box is firmly pressed against the flange *n*.

Then the main operating lever *f* is turned to the vertical position to open the valve *d*. This causes compressed-air to enter behind the piston of the main cylinder *k* and to force the cartridge barrel *i* to the left until it bears against the nozzle flange *n*. In this position the stem of the valve *e* is situated above the push rod *g*. The magazine *l*, which turns on a horizontal axis, is filled with core sand, the end faces being provided with openings similar to the arrangement of holes in a military revolver. On its way forward, the cartridge barrel is filled with core sand.

If now the lever *f* is jerked to the right and back, the valve *e* is suddenly opened and closed again, permitting the compressed-air to enter at the back of the wad of sand in the barrel *i*, with the result that the sand contained therein is shot through the opening in the flange *n* into the core box in which the sand is compressed by the action of the air. Turning the lever *f* to the left causes the cartridge barrel to return to its starting position. The magazine now being turned with a jerk until the next hole is opposite the cartridge barrel, the sand collapsing and filling up the cavity cut by the cartridge barrel.

If the contents of the core box exceed the capacity of the cartridge (10 lb.) the operation is repeated until the core is filled, a "shot" taking about 10 sec. When in continuous operation, the machine will consume about 19 cub. ft. of free air per min.

An example of the type of work done by the Revolver machine is shown in Figs. 4 to 6, which illustrate the making of a motor-cycle cylinder core. It is $11\frac{1}{2}$ in. long by $2\frac{1}{4}$ in. dia. It should be noted that in this case there is no straight line of filling, which obviously involves directional changes for the incoming stream of sand. With the exception of a small section on the upper central portion, the sand is properly compressed through the entire core. To overcome this an auxiliary shot is applied at a second opening, the result being shown in Fig. 6. To mould the entire core, including resetting the box, the main and auxiliary shots and the placing on the drying tray, requires only 30 sec., as against 10 to 12 min. with ordinary hand work.

The machine is sold in this country by the Coleman Foundry Equipment Company, Limited, of 14, Southampton Street, Strand, London, W.C.2.

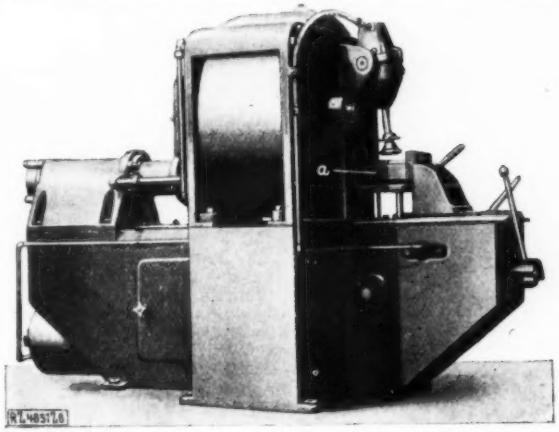


FIG. 1.—THE REVOLVER CORE-MAKING MACHINE.
a, Core box immediately before clamping.

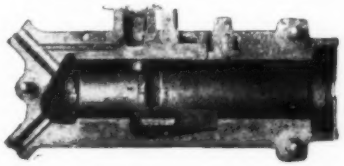
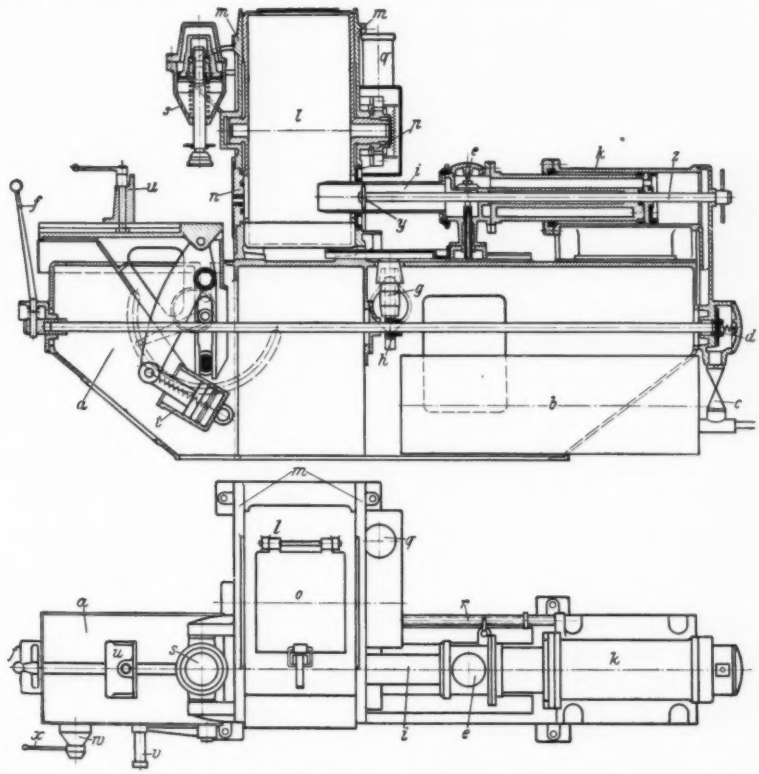


FIG. 4.—CORE BOX FOR MOTOR-CYCLE CYLINDER.

FIG. 5.—CORE BOX FILLED BY MAIN SHOT.

FIG. 6.—CORE BOX AFTER APPLICATION OF AUXILIARY SHOT.



FIGS. 2 AND 3.—PLAN AND ELEVATION OF THE REVOLVER CORE-MAKING MACHINE.
a, Bed of the machine. *b*, Compressed-air tank. *c*, Main shut-off valve. *d*, Air valve for reciprocating motion of the cartridge piston. *e*, Shooting valve. *f*, Main operating lever. *g*, Push rod with rack for operating shooting valve *e*. *h*, Pinion. *i*, Cartridge barrel. *k*, Main cylinder, with piston. *l*, Magazine. *m*, Walls enclosing magazine. *n*, Flange with shooting nozzle. *o*, Lid of drum. *p*, Ratchet for indexing drum. *q*, Indexing cylinder. *r*, Indexing gear. *s*, Upper clamping cylinder. *t*, Lower clamping cylinder. *u*, Block. *v*, Hand lever for adjusting *t*. *w*, Air valve for actuating *s* and *t*. *x*, Valve lever. *y*, Stripper. *z*, Stripper rod.

Company Meeting.

Edgar Allen & Company, Limited.—At the annual meeting of Messrs. Edgar Allen & Company, Limited, held at Imperial Steelworks, Sheffield, on June 25, the CHAIRMAN, in dealing with the balance-sheet and the loss on the financial year, referred to the intensification of the depression from which the company, as part of the steel and engineering industries, had suffered during the year, and suggested that the continued decline in these trades should cause the Government grave concern, not only from the unemployment point of view, but also in regard to national security; and that the British workman, who had for years protected his own labour, should not be content to see this country flooded with steel produced abroad, under conditions which he would not himself tolerate. The company was in a strong financial position, having no debentures or prior charges, and was well equipped to take advantage of any revival in trade. At an extraordinary general meeting, which followed, resolutions were passed adopting revised articles and alterations to the company's memorandum of association.

Trade Talk.

Middlesbrough and the Tees celebrated their industrial centenary last week.

Production began recently at the newly-erected works at Darlington of the Darlington Rustless Iron & Steel Company, Limited.

Sir R. Ropner & Company, Limited, West Hartlepool, have given an order to Messrs. William Gray & Company, Limited, for a steamer of 9,000 tons deadweight.

The North British Locomotive Company, Limited, Springburn, Glasgow, have secured from the Crown Agents for the Colonies an order for five locomotives for service on the Gold Coast.

Messrs. Barclay, Curle & Company, Limited, are to undertake an extensive dock scheme at Elderslie, Scotstoun, which involves the construction of a large new graving dock and probably also a new fitting-out wharf.

The summer meeting of the Whitworth Society took place at Sheffield on Tuesday, July 7, when a visit was paid to the works of Messrs. John Brown & Company, Limited, and to the adjoining works of Messrs. Thos. Firth & Sons.

A noteworthy effort in the high-speed manufacture of belting was recently accomplished in the East London works of the Silvertown Company. The manufacture of a belt 388 ft. long, 24 in. wide, by 4-ply, was begun by "A" shop at 10 a.m. one day, and the belt was ready for despatch at 9.30 a.m. on the following day. The finished belt weighed 1,500 lbs.

Messrs. Samuel Hodge & Sons, Limited, 130/132, Leadenhall Street, London, E.C.3, have taken over all business connections of the Howden-Buell Combustion Company, Limited, with all rights and interests in the Howden-Buell system of pulverised-coal firing, the British Rema pulverising mills and vacuum system, and other engineering specialities with which they are connected.

It is announced that the offer to purchase the whole of the shares of Messrs. William Cooke & Company, Limited, made by the Templeborough Rolling Mills, Limited, has been accepted by more than the requisite percentage, which was fixed at 90 per cent. Payment will be made in cash in a few days in accordance with the offer of 10s. 3d. for each preference and 6s. 3d. for each ordinary share. It is intimated that all the operating departments of Messrs. William Cooke & Company will be continued as at present.

Messrs. Duncan Stewart & Company, Limited, London Road Ironworks, Glasgow, have received from Russia an order for forging presses valued at £50,000. This is stated by Mr. Saul. G. Bron to be the first order under the new scheme of credits of the British Government. It is the second contract the firm have received from Russia this year, as in February they were asked to supply three presses for the manufacture of locomotive crankshafts and other locomotive forgings. The present order is for eight large high-speed forging presses designed to deal with steel ingots for a number of purposes.

Negotiations which have been proceeding for a considerable time have now reached an advanced stage with a view to the formation of a new company to acquire the Ayrshire interests of Messrs. William Baird & Company, Limited, and their associated company, the Sanquhar & Kirkconnel Collieries, Limited, and the Dalmellington Iron Company, Limited. It is particularly stated that what is proposed is not a purchase but a merger of interests, which will involve the paying out in cash to the preference shareholders of the Dalmellington Company in terms of the articles of association and the issue to the ordinary shareholders of that company of shares in the new company. In addition the ordinary shareholders will receive a limited amount of cash.

The first brick of the coke-oven plant which is to be erected at the Irlam works of the Lancashire Steel Corporation, Limited, was ceremonially laid on Thursday, July 2, by Mrs. J. Sinclair Kerr, in the presence of an interested company. This new equipment is part of important developments going forward at Irlam under the ægis of the Lancashire Steel Corporation, which is putting up new blast furnaces and rolling mills and, in conjunction with the Manchester Ship Canal Company, building a dock so that the import of iron ore and the export of steel may be facilitated. Mrs. J. Sinclair Kerr expressed the hope that the occasion they celebrated would lay the foundation of long-continued prosperity for the Lancashire steel industry. Good-quality cheap coke was, she said, the basis of economic steel production, and that day they saw the beginning of the construction of a battery of coke ovens which would produce coke as cheaply and as well as it could be produced in any country in the world.

We have received from Messrs. Edward Bennis & Company, Limited, 28, Victoria Street, London, S.W.1, an interesting article describing the power plant installed at the London General Omnibus Company's works at Chiswick. The boiler plant includes four Lancashire boilers fitted with "Bennis" patent sprinkler stokers and self-cleaning air-draft furnaces, arranged to take the air from an air-heater at a temperature of 300 deg. Fah. The preheated air is supplied from a Galloway Supermiser. The furnaces are the latest development in combustion engineering for internally-fired boilers. The air for combustion is fed into each hollow furnace trough through suitably arranged nozzles. This system is unique to the "Bennis" stokers, and is claimed to have created a new standard in combustion engineering, both from an evaporative and efficiency standard. The plant is equipped with a "Bennis" coal elevator and distributing conveyor. The ash-handling plant includes a "Bennis" U-link tray conveyor, which travels horizontally in a culvert built below the firing floor.

According to cabled reports of the meeting of the South African Iron & Steel Industrial Corporation, Limited, at Johannesburg recently, Dr. Van der Bijl, who presided, said that the total funds authorised for the establishment of the industry amounted to £5,500,000, and the total estimated cost of the establishment would be £5,489,000. The iron ore in Pretoria town and lands was estimated at 48,000,000 tons, averaging 45 per cent. of metallic iron containing a fairly high percentage of silica. The board had acquired properties on the Crocodile River containing 100,000,000 tons of extremely pure hematite iron with 68 per cent. of metallic iron. A mixture of the two, it was estimated, would produce pig-iron at Pretoria at under 30s. a ton, whereas Continental pig-iron landed and conveyed to the Rand fetched up to 127s. It was proposed to roll 150,000 tons of steel products yearly. Deliveries of machinery would begin early next year. The gross profit on 150,000 tons was estimated at £765,000 yearly. After deducting £215,000 for administration, general charges, interest on debentures, and the 6 per cent. "A" shares, etc., £550,000 would be left for the redemption of debentures, depreciation, reserves, and a dividend on the "B" shares.

Reports and Dividends.

Wellman Smith Owen Engineering Corporation, Limited.—Net profit, £7,662, reducing the debit balance to be carried forward to £3,533.

Hadfields, Limited.—The directors have decided to defer payment of the dividend on the 4½ per cent. cumulative preference shares due on June 30.

Ward & Goldstone, Limited.—Net profit, £10,726; brought in, £23,139; dividend of 7 per cent. on the ordinary shares; to reserve, £10,000; carried forward, £16,107.

A. & J. Main & Company, Limited.—Profit, £7,183; to reserve against depreciation, £2,077; dividend on the ordinary shares of 2½ per cent.; carried forward, £4,232.

Fairfield Shipbuilding & Engineering Company, Limited.—Payment of the dividend on the 6 per cent. cumulative preference shares for the half-year to June 30 is postponed.

Belliss & Morcom, Limited.—Profit, £22,368; brought in, £302,191; final dividend on the ordinary shares of 7½ per cent., making 12½ per cent., free of tax; carried forward, £301,270.

Metal Box Company, Limited.—Final dividend of 5 per cent. on the ordinary shares, making 8½ per cent. for the year; £18,850 to general reserve, making £100,000; £2,115 forward.

W. & T. Avery, Limited.—Net profit, £104,270; brought in, £59,035; dividend of 10 per cent. on the ordinary shares, making 15 per cent. for the year; to reserve, £13,451; carried forward, £56,268.

Millom & Askam Hematite Iron Company, Limited.—The directors have decided to defer payment of the dividend on the 7 per cent. cumulative participating preference shares for the half-year to March 31.

Petters, Limited.—Net profit, £35,334; brought in, £39,037; preference dividends, £11,624; interest on funding certificates, £1,435; funding certificate redemption fund, £1,064; dividend on the ordinary shares of 6 per cent., £5,231; to reserve, £10,000; carried forward, £45,015.

Personal.

Mr. J. C. C. Holding, vice-president and manager of the American Stainless Steel Company, Pittsburgh, is now on a business visit to this country.

Mr. W. W. Coleman, president of the Bucyrus-Erie Company, Milwaukee, and a director of Ruston-Bucyrus, Limited, Lincoln, has returned to America after a prolonged visit to this country.

Mr. G. G. Coppel, managing director of Messrs. J. J. Saville & Company, Limited, Triumph Steelworks, Sheffield, is to retire from active business at the end of July.

Mr. J. J. Sargent, who has been works manager for Messrs. Richardsons, Westgarth & Company, Limited, at their Middlesbrough works for six years, is leaving Tees-side.

Mr. Charles Mitchell, joint vice-chairman and managing director of Dorman, Long & Company, has been elected chairman of the company in place of the late Sir Hugh Bell.

Geheimrat Professor Fritz Wüst, late director of the Kaiser-Wilhelm Iron Research Institute at Düsseldorf, has been elected an honorary member of the Iron and Steel Institute.

Viscount Ednam, chairman of the Earl of Dudley's Round Oak Works, Limited, and Mr. Robert S. Hilton, managing director of the United Steel Companies, Limited, have accepted seats on the Council of the Iron and Steel Institute.

Mr. T. Nightingale, managing director of Sheffield Steel Products, Limited, has been appointed a member of the Federation of British Industries' Argentine Committee, which has been formed to follow up the results of the recent British Empire Exhibition at Buenos Aires.

Under the operation of Colvilles' superannuation scheme, whereby employees are expected to retire automatically when they reach the age of 65, last week four veterans of the firm retired. They are Mr. Thomas Coughtrie, traffic department manager; Mr. John Thomas, manager of the boilermaking department; Mr. George Grant, manager of the joinery and patternmaking departments, and Mr. Robert M'Millan, of the laboratory staff. Mr. Coughtrie was presented with a wireless set, an umbrella for himself and a handbag and umbrella for Mrs. Coughtrie. Mr. Thomas received a wallet of Treasury notes, Mr. Grant a wallet of Treasury notes, and a travelling case for Mrs. Grant, and Mr. M'Millan a set of bowling-green bowls, with a gold wristlet watch and bracelet for Mrs. M'Millan.

Wills.

Leaf, Major H. M., of Victoria Street, London, S.W., electrical and mechanical engineer £26,608

Lane, F. L., of Headingley, Leeds, late managing director of the Leeds Forge Company, Limited £16,362

Richardson, W. B., managing director of Messrs. Richardson, Tuer & Company, Limited, Hope Foundry, Farnworth £11,109

Darby, Christopher, of Cradley Heath, Staffs, managing director of Messrs. Christopher Darby, Limited, iron and steel merchants £16,552

Obituary.

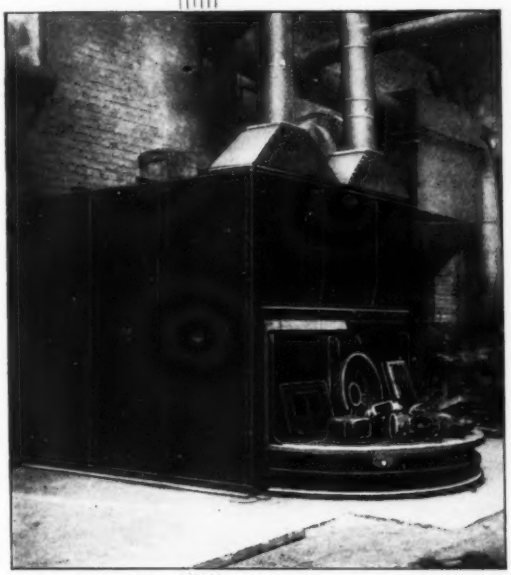
The death has occurred in Glasgow of Mr. David Cooke, chief draughtsman of Messrs. Pott, Cassels & Williamson, Limited, engineers and iron and brass founders, Motherwell.

Andrew Monteith, Motherwell, employed as a sprayer at the 36-in. mill in the Lanarkshire Steelworks, died in the Glasgow Royal Infirmary as a result of falling into the roughing-rolls shaft pit and having his foot torn off.

Mr. Stanley Faber Prest, chairman of the Parsons Marine Steam Turbine Company, Limited, Wallsend-on-Tyne, and of C. A. Parsons & Company, Limited, Newcastle-upon-Tyne, has died at the age of 72 years. He was appointed chairman of the companies last March, in succession to the late Sir Charles A. Parsons, and had been a director for many years.

Mr. Archibald Fulton Craig, founder of Messrs. A. F. Craig & Company, Limited, ironfounders and boilermakers, Paisley, died recently at his residence, Belmont, Castlehead, Paisley, in his ninetieth year. He served an apprenticeship in the Vulcan Works, Paisley, and later went to the United States, where he gained considerable experience in engineering. He returned to Paisley in 1868 and founded Messrs. A. F. Craig & Company, Limited.

XUM



A Further Advance in SAND-BLASTING...

The illustration shows a new design of room embodied in a plant recently supplied to an important Foundry.

The principal feature consists of a turntable which is half in and half out of the room. The work is placed on the outer half, the table revolves through 180 degrees, and the sand-blasting is carried on inside the room. When finished the table is again revolved, the work unloaded and a fresh charge of work comes round in front of the operator.

The chief advantages of this design are :—

1 The facility in loading the work, especially when dealing with heavy castings as they can be loaded directly on to the table by means of an overhead crane.

2 The operator's time is taken up in sand-blasting only, there is no necessity for him to handle the castings in any way.

3 Time saved by avoiding the opening and shutting of doors for loading and unloading the work.

4 The saving of floor area, as the room itself can be much smaller, the operator only requiring to work close to the table. This saving means less horse-power required for the exhaust fan and less excavation for the hopper under the room.

For full particulars and prices apply to :—

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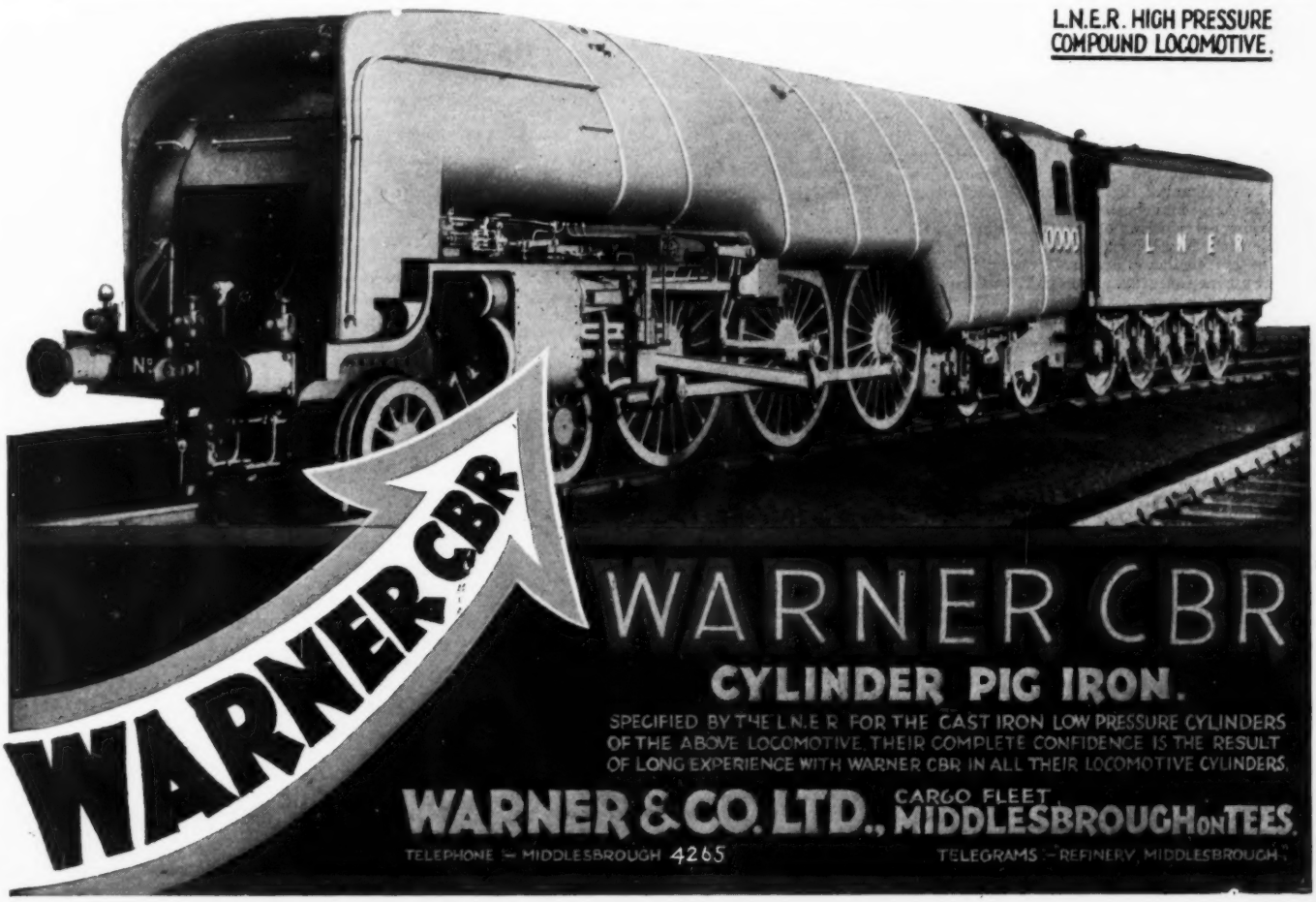

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Iron and Steel Markets.

Pig-Iron.

MIDDLESBROUGH.—The rather better tone of the Cleveland iron market is influenced by, among other things, the rise in European prices and the compromise on the Hoover war debt proposals. Although no material expansion can be reported in the volume of business passing, there are more inquiries in circulation. It is now generally assumed that the import of foreign iron into the Cleveland area will cease as Continental prices have sharply advanced, but Midlands competition is still a factor to be reckoned with, and considerable quantities are now regularly arriving by rail, despite a freight charge of 13s. 4d. per ton. For the moment, business with Scotland is very quiet, July being the holiday month on Clydeside. As a consequence, deliveries in many instances are suspended. The accountant's certificate of the average net realised price of No. 3 Cleveland G.M.B. pig-iron for the second quarter of the year shows the figure to have been 55s. 1.93d. per ton, compared with 56s. 3.37d. per ton in the first quarter, and under the sliding scale Cleveland blast-furnacemen's wages have been reduced as from Sunday last by 1¼ per cent., leaving them now only 1 per cent. above the standard. To all destinations, except Scotland, the fixed minimum prices are still unchanged as follow:—No. 1 Cleveland foundry iron, 61s.; No. 3 Cleveland G.M.B., 58s. 6d.; No. 4 foundry, 57s. 6d.; No. 4 forge, 57s. per ton.

The East Coast hematite trade is now more stable. The volume of business passing is more encouraging than it has been for some time past. Competition is unrestricted and prices are a matter for individual negotiation, but for some weeks past the official market quotation for mixed numbers has been 62s. 6d. per ton and that is still the ruling figure, although it is understood that concessions could be secured for really substantial orders. Further business has been booked with Sheffield and steady deliveries are being made to the Midlands. In spite of offers of cheap foreign hematite, merchants continue to negotiate a few sales in Denmark and Italy. There is no change in the quotation of 66s. for Bessemer mixed numbers on the North-West Coast.

LANCASHIRE.—The slight improvement in the pig-iron market is due partly to a small increase in the demand for textile machinery, and partly to a determined belief, on all sides, in the stability of the market. Several buyers have covered their needs for the next two or three months. Prices in general have changed little. For delivery to consumers in the Manchester zone, Derbyshire and Staffordshire descriptions of No. 3 are quoted at 67s. per ton, with North-East Coast iron also at 67s. The price of Northamptonshire foundry is 65s. 6d. and Derbyshire forge 62s. Scottish foundry brands are quoted at about 87s. 6d., with West Coast hematite iron at 80s. 6d.

MIDLANDS. The market as a whole is still very quiet, and most of the ironfounders are badly in need of more business. The heavy industry in particular is depressed. For delivery to Birmingham and Black Country stations the furnaces still quote 62s. 6d. for Northants No. 3 and 66s. for Derbyshire, North Staffordshire and Lincolnshire No. 3.

SCOTLAND.—Trade in Scotland has been interrupted by the holidays. Business is so poor, however, that manufacturers are glad of the opportunity to close down their foundries, and all hope that orders may accumulate in the interval. Scottish pig-iron makers are quoting as a fixed minimum price 71s. per ton for No. 3 foundry, f.o.t. furnaces, with a minimum of 2s. 6d. per ton extra for No. 1. The price of Continental No. 3 is 52s., f.o.t. Grangemouth. Middlesbrough No. 3 is at 58s. 6d.

Finished Iron.

The market for finished iron is still very depressed. Orders are small and scarce, and the mills can only work spasmodically. The marked-bar makers are somewhat better situated than the others. Quotations for crown bars still fluctuate widely, anything from £9 5s. to £10 being quoted, with nut and bolt iron at £8 10s. to £8 12s. Staffordshire marked bars are maintained at £12. For common nut and bolt work the Belgian product is being purchased, the present price delivered to Black Country works being at about £4 15s.

Steel.

The finished-steel market is quiet. The demand for plates and sectional material is restricted. Other sections of the steel market show no change. There is still a weak demand for steel bars, but prices are maintained. The position of the sheet trade is a little better in some instances. The demand for galvanised sheets has been rather more active, although the market is still far from satisfactory. There are now few sellers of Continental semis. The low quotations of some weeks back are not now available, stimulating an increased inquiry. Prices of British semis are maintained on the whole, although concessions may be obtained for any substantial tonnage.

Scrap.

More business has been done in the Cleveland area this week, although there has been no general rise in prices. Ordinary-quality cast-iron scrap is now down to 42s. 6d., with good machinery quality at 44s. The market in the Midlands is dull. Good heavy machinery cast-iron scrap in cupola sizes is offered at 47s. 6d., with light cast iron at 37s. 6d. The Scottish market is in no better a position. Orders are very scarce. First-class machinery metal, in pieces not exceeding 1 cwt., is quoted at 48s. 6d., while ordinary cast-iron scrap to the same specification is at 43s. 6d. The above prices are all delivered consumers' works.

Metals.

The outlook of the non-ferrous metal markets generally is obscure. The buoyant tone which characterised the markets after the announcement of the Hoover proposals has to some extent subsided. The situation which has arisen with regard to the economic position of Germany has done much to bring about the present reactionary tone. Moreover, as conditions in the consuming trades have not improved, it was not surprising that quiet conditions developed after the first flush of enthusiasm over the war debts question had died down.

Copper.—The market remains unsettled. The reactionary tone of last week has further developed. Consumptive buying has almost disappeared, and the outlook at the moment is unfavourable.

Closing quotations :—

Cash.—Thursday, £34 to £34 1s. 3d.; Friday, £34 17s. 6d. to £35; Monday, £33 17s. 6d. to £33 18s. 9d.; Tuesday, £33 11s. 3d. to £33 12s. 6d.; Wednesday, £33 5s. to £33 7s. 6d.

Three Months.—Thursday, £34 13s. 9d. to £34 15s.; Friday, £35 11s. 3d. to £35 12s. 6d.; Monday, £34 11s. 3d. to £34 12s. 6d.; Tuesday, £34 5s. to £34 6s. 3d.; Wednesday, £34 to £34 2s. 6d.

Tin.—Fluctuations in the tin market have been erratic, the news from Germany exerting an adverse influence on sentiment. However, the time is approaching when restriction will have its effect on current supplies, and the general position should be improved.

Official closing prices :—

Cash.—Thursday, £113 to £113 2s. 6d.; Friday, £114 to £114 2s. 6d.; Monday, £108 10s. to £108 15s.; Tuesday, £109 10s. to £109 15s.; Wednesday, £107 15s. to £117 17s. 6d.

Three Months. — Thursday, £114 10s. to £114 12s. 6d; Friday, £115 15s. to £116; Monday, £110 5s. to £110 10s.; Tuesday, £111 5s. to £111 10s.; Wednesday, £109 10s. to £109 12s. 6d.

Spelter.—Business with consumers is only moderate, and the market is unsettled. The meeting of zinc producers held at Ostend on Friday resulted in an agreement being reached for a general curtailment of output by 45 per cent. European, Canadian, Australian and Mexican producers are included in the scheme on the basis arranged at Ostend last year. The United States is not included, the exports from America of spelter produced from domestic ore being negligible.

Daily fluctuations :—

Ordinary. — Thursday, £11 15s.; Friday, £12 7s. 6d.; Monday, £12 7s. 6d.; Tuesday, £12 13s. 9d.; Wednesday, £12 7s. 6d.

Lead.—The outlook is uncertain, but the general position of lead is not unsatisfactory.

The week's prices have been :—

Soft Foreign (Prompt).—Thursday, £12 3s. 9d.; Friday, £12 13s. 9d.; Monday, £12 11s. 3d.; Tuesday, £12 13s. 9d.; Wednesday, £12 5s.

Contracts Open.

Cairo, August 1.—Four centrifugal or turbine pumps, etc., for the Egyptian Ministry of Public Works. The Department of Overseas Trade. (Reference G.X. 10,536.)

Hertford, July 20.—80 yds. of 6-in. dia. water mains, etc., for the Corporation. The Borough Surveyor and Engineer, The Castle, Hertford. (Fee £2 2s., returnable.)

Johannesburg, July 23.—Three miles of 6,600-volt cable and 23 miles of various cables for 660 volts, for the City of Johannesburg. The Department of Overseas Trade. (Reference A.X. 10,974.)

London, S.W., July 17.—Spare parts of locomotive engines, for the South Indian Railway Company, Limited, 91, Petty France, Westminster, S.W.1. Messrs. R. White & Partners, consulting engineers, 3, Victoria Street, Westminster, S.W.1. (Fee 10s., non-returnable.)

Midsomer Norton, July 28.—6,300 yds. of 6-in. C.I. pipe, 3,300 yds. of 5-in. C.I. pipe, and the making of sundry connections to existing pipes, etc., for the Urban District Council. Messrs. Parker, Pearson & Ross Hooper, engineers, Dallas Chambers, Chippenham, Wilts. (Fee £2, returnable.)

Singapore, August 12.—Cast-iron or steel pipes, etc., for the Singapore Municipal Water Department. The Department of Overseas Trade. (Reference G.X. 10,552.)

Waltham Abbey, July 20.—Two centrifugal sewage pumps, etc., for the Waltham Holy Cross Urban District Council. Mr. W. C. Holloway, engineer and surveyor, Town Hall, Waltham Abbey.

Alloys for Use at High Temperatures.

(*Concluded from page* 44.)

eutectic, the proportions of which favourably affect the casting properties of the alloys. Secondly, carbon increases the strength of the alloys, especially in the prolonged-stress tests at 800 deg. C. Thirdly, it appears to form a part of a complex carbide which brings about an increased resistance to prolonged stress at a critical composition (about 1.5 per cent. carbon). Silicon, to the extent of 1 per cent., slightly improves the carbon-bearing alloys. It appears to increase the fluidity.

Melting-Point Determination.

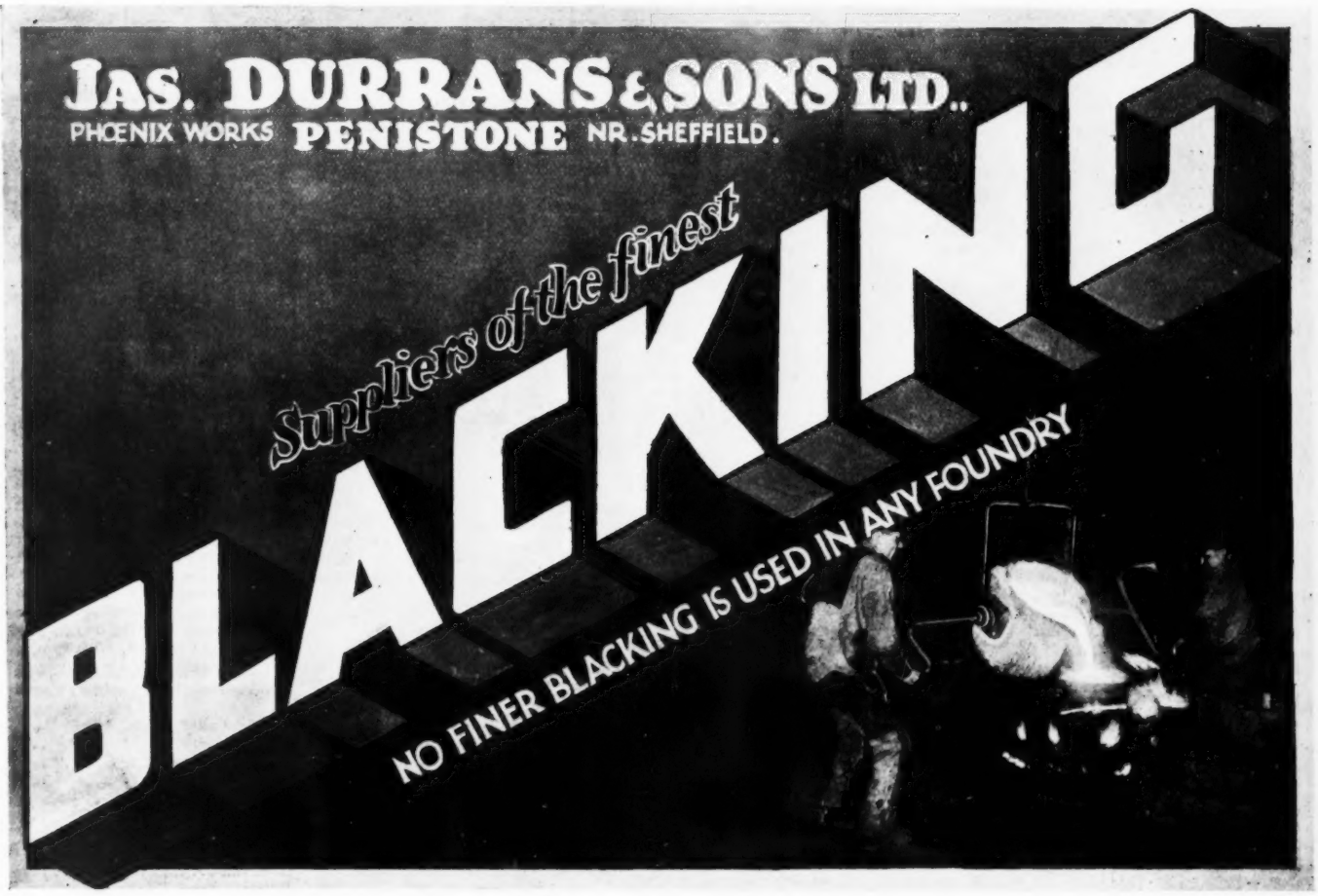
In view of the favourable properties of the alloy containing 1.5 per cent. of carbon and 1 per cent. of silicon, together with 30 per cent. of chromium, 4 per cent. of tungsten, 30 per cent. of nickel, and the residue iron, the melting range of this material was determined. Heating and cooling curves were determined by means of a platinum/platinum-rhodium thermocouple protected by a silica sheath. The ingots, which weighed about 60 to 70 grms., were melted in a crude alumina crucible under an atmosphere of nitrogen.

The results, which are set forth in full in Table V, show that the melting point of this alloy, No. 183 (C 1.5, Si 1), is appreciably lower than that of some of the other alloys included. This alloy is found to melt between 1,285 and 1,314 deg. C., whereas the basic alloy without carbon or silicon does not melt until 1,370 deg. C. The ternary alloy containing somewhat similar proportions of iron, chromium and nickel melts at about 1,400 to 1,406 deg. C.

For purposes of casting, the reduction in temperature from 1,420 deg. C. (the melting point of the binary 80/20 nickel-chromium alloy) to 1,285 to 1,315 deg. C. (the melting point of N.P.L. alloy No. 183) effects a marked improvement, as it permits the use of casting conditions allied to those employed in the founding of cast iron.

We extend to "Stahl und Eisen," the leading German technical publication devoted to the iron and steel industries, our congratulations on attaining its fiftieth anniversary. The occasion was marked by the publication of a special number containing an interesting story of the development of the industries it serves during the last fifty years.

XUM


JAS. DURRANS & SONS LTD.,
PHŒNIX WORKS PENISTONE NR. SHEFFIELD.
Suppliers of the finest
BLACKING
NO FINER BLACKING IS USED IN ANY FOUNDRY

CAST IRON FLANGED PIPES

2 in.–12 in. & CONNECTIONS. to 24 in. dia.

WE HAVE FIFTY-TWO YEARS OF ACCUMULATED EXPERIENCE AND METAL PATTERNS.

JAMES & RONALD RITCHIE, LTD.,

Telephone: 3852 (2 Lines). **MIDDLESBROUGH.** Telegrams: "Ritchie, Middlesbrough."

Colvilles
PIG IRON
BRANDS "DALZELL", "GLENGARNOCK", "CLYDE" & "MONKLAND"
HIGH GRADE HEMATITE PIG IRON
SPECIAL & ORDINARY FOUNDRY QUALITIES & FORGE
SPECIAL REFINED WITH TOTAL CARBON
GUARANTEED NOT EXCEEDING
COLVILLES LTD.
HEAD OFFICE :- 195 WEST GEORGE STREET, GLASGOW.
TELEGRAMS. COLVILLETT GLASGOW. TELEPHONES GLASGOW. CENTRAL 9277/94
LONDON OFFICE :- 6 SPRING GARDENS, COCKSPUR ST. S.W.1
TELEGRAMS, COLVILLE, WESTRAND, LONDON. TELEPHONES, LONDON, WHITEHALL 1566/7

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	33	5	0
Three months	34	0	0
Electrolytic	36	0	0
Tough	34	5	0
Best selected	34	15	0
Sheets	64	0	0
India	45	0	0
Wire bars	38	2	6
Do., August	38	2	6
Do., September	38	2	6
Ingot bars	38	2	6
H.C. wire rods	40	0	0
Off. av. cash, June	35	17	6 15/16
Do., 3 mths., June	36	10	10 11/16
Do., Sttlmnt., June	35	17	4 7/16
Do., Electro, June	39	7	10 1/16
Do., B.S., June	37	10	10
Do., wire bars, June	39	16	4 1/16
Solid drawn tubes			10½d.
Brazed tubes			10½d.
Wire			7d.

BRASS.

Solid drawn tubes	7d.
Brazed tubes	11d.
Rods, drawn	8d.
Rods, extd. or rlld.	5d.
Sheets to 10 w.g.	7⅛d.
Wire	7⅛d.
Rolled metal	7⅛d.
Yellow metal rods	5d.
Do. 4 × 4 Squares	5½d.
Do. 4 × 3 Sheets	5½d.

TIN

	£	s.	d.
Standard cash	107	15	0
Three months	109	10	0
English	109	5	0
Bars	112	15	0
Straits	111	5	0
Australian	110	10	0
Eastern	116	2	6
Banca	114	0	0
Off. av. cash, June	105	0	8 5/16
Do., 3 mths., June	106	13	5 13/16
Do., Sttlmt., June	105	1	1 1/16

SPELTER.

	£	s.	d.
Ordinary	12	7	6
Remelted	11	12	6
Hard	9	10	0
Electro 99.9	15	0	0
English	13	5	0
India	11	10	0
Zinc dust	19	0	0
Zinc ashes	2	15	0
Off. aver., June	11	10	2 15/16
Aver. spot, June	11	5	4 15/16

LEAD.

	£	s.	d.
Soft foreign ppt.	12	5	0
English	13	15	0
Off. average, June	11	15	4 1/16
Average spot, June	11	11	7 15/16

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	20	0	0
Do., V.M. ex-whf.	19	5	0
Rods	22	0	0
Boiler plates	14	0	0
Battery plates	16	0	0

ANTIMONY.

	£	s.	d.
Special brand, Eng.	34	0	0
Chinese	23	2	6
Crude	21	0	0

QUICKSILVER.

	£	s.	d.
Quicksilver	16	15	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	£7 7 6
45/50%	£10 7 6
75%	£15 2 6
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% c. free	4/2 lb. Mo.
Ferro-titanium—	
23/25% carbon-free	9¼d. lb.
Ferro-phosphorus, 20/25%	£15 10 0
Ferro-tungsten—	
80/85%	1/8½ lb.
Tungsten metal powder—	
98/99%	1/11½ lb.
Ferro-chrome—	
2/4% car.	£28 0 0
4/6% car.	£21 5 0
6/8% car.	£20 12 6
8/10% car.	£19 17 6
Ferro-chrome—	
Max. 2% car.	£29 17 6
Max. 1% car.	£33 15 0
Max. 0·70% car.	£35 12 6
70% carbon-free	9¾d. lb.
Nickel—99%	£170 0 0 to £175 0 0
Ferro-cobalt	8/9 lb.
Aluminium 98/99%	£85 0 0
Metallic chromium—	
96/98%	2/7 lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export	(nom.) £9 0 0
Metallic manganese—	
94/96% carbonless	1/3 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	£0 2 0
Finished bars, 18% tungsten	£0 2 9

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 7/16 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅜ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£	s.	d.		£	s.	d.
South Wales							
Heavy steel	1	19	0	to	2	1	6
Bundled steel and shrngs.	1	14	0	to	1	18	6
Mixed iron and steel					1	16	0
Heavy cast iron	2	1	6	to	2	3	6
Good machinery for foundries	2	5	0	to	2	7	6
Cleveland—							
Heavy steel					1	17	6
Steel turnings					1	5	0
Cast-iron borings					1	2	0
Heavy forge					2	13	0
W.I. piling scrap					2	10	0
Cast-iron scrap	2	2	6	to	2	4	0
Midlands—							
Light cast-iron scrap					1	17	6
Heavy wrought					2	7	6
Steel turnings						—	
Scotland—							
Heavy steel					1	17	6
Ordinary cast iron					2	3	6
Engineers' turnings					1	5	0
Cast-iron borings					1	10	0
Wrought-iron piling					2	7	6
Heavy machinery					2	8	6

London—Merchants' buying prices delivered yard.

	£	s.	d.
Copper (clean)	27	0	0
Brass	18	0	0
Lead (less usual draft)	10	0	0
Tea lead	7	0	0
Zinc	5	10	0
New aluminium cuttings	52	0	0
Brazier copper	24	0	0
Gunmetal	23	0	0
Hollow pewter	72	0	0
Shaped black pewter	53	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	61/-
Foundry No. 3	58/6
Foundry No. 4	57/6
Forge No. 4	57/-
Hematite No. 1	63/-
Hematite M/Nos.	62/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	73/6
,, d/d Birm.	84/6
Malleable iron d/d Birm.	115/-
Midlands—	
Staffs common*	—
,, No. 4 forge*	61/-
,, No. 3 fdry.*	66/-
Shrops basic	—
,, Cold blast, ord.	—
,, ,, roll iron	—
Northants forge*	57/6
,, fdry. No. 3*	62/6
,, fdry. No. 1*	65/6
Derbyshire forge*	61/-
,, fdry. No. 3*	66/-
,, fdry. No. 1*	69/-
,, basic*	—

*d/d Black Country dist.

Scotland—	
Foundry No. 1	73/6
,, No. 3	71/-
Hem. M/Nos. d/d	70/-
Sheffield (d/d district)—	
Derby forge	58/6
,, fdry. No. 3	63/6
Lincs forge	—
,, fdry. No. 3	63/6
E.C. hematite	76/6
W.C. hematite	82/6
Lancashire (d/d eq. Man.)—	
Derby forge	62/-
,, fdry. No. 3	67/-
Staffs fdry. No. 3	67/-
Northants fdry. No. 3	65/6
Cleveland fdry. No. 3	67/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	87/6
Clyde, No. 3	87/6
Monkland, No. 3	87/6
Summerlee, No. 3	87/6
Eglinton, No. 3	87/6
Gartsherrie, No. 3	87/6
Shotts, No. 3	87/6

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.		£	s.	d.
Bars (cr.)	9	15	0	to	10	0	0
Nut and bolt iron	8	10	0	to	8	12	6
Hoops	10	10	0	to	12	0	0
Marked bars (Staffs) f.o.t.					12	0	0
Gas strip	10	10	0	to	12	0	0
Bolts and nuts, ¾ in. × 4 in.					12	5	0
Steel—							
Plates, ship, etc.	8	15	0	to	8	17	6
Boiler plts.	9	0	0	to	9	15	0
Chequer plts.					10	7	6
Angles					8	7	6
Tees					9	7	6
Joists					8	15	0
Rounds and squares, 3 in. to 5½ in.					9	7	6
Rounds under 3 in. to ⅜ in. (Untested)				6	12	6	& up.
Flats—8 in. wide and over					8	12	6
,, under 8 in. and over 5 in.					8	17	6
Rails, heavy	8	5	0	to	8	10	0
Fishplates					12	0	0
Hoops (Staffs)					9	5	0
Black sheets, 24g.	8	5	0	to	9	5	0
Galv.cor.shts.24g.	9	10	0	to	9	15	0
Galv. flat sheets	10	0	0	to	10	5	0
Galv. fencing wire, 8g. plain					12	0	0
Billets, soft					5	0	0
Billets, hard					6	12	6
Sheet bars	4	12	6	to	4	17	6
Tin bars					4	12	6

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	10½d.
Sheet to 10 w.g.	12d.
Wire	12½d.
Rods	11½d.
Tubes	1/6d.
Castings	11½d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
3/- to 10 g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	17.01
No. 2 foundry, Valley	17.00
No. 2 foundry, Birm.	12.00
Basic	17.26
Bessemer	18.76
Malleable	18.76
Grey forge	18.26
Ferro-mang. 80%	85.00
O.-h. rails, h'y, at mill	43.00
Billets	29.00
Sheet bars	29.00
Wire rods	35.00
	Cents.
Iron bars, Phila.	2.09
Steel bars	1.65
Tank plates	1.65
Beams, etc.	1.65
Skelp, grooved steel	1.65
Skelp, sheared steel	1.65
Steel hoops	1.85
Sheets, black, No. 24	2.40
Sheets, galv., No. 24	2.90
Sheets, blue an'l'd, No. 13	2.00
Wire nails	1.80
Plain wire	2.20
Barbed wire, galv.	2.55
Tinplates, 100-lb. box	$5.00

COKE (at ovens).

Welsh foundry	22/6 to 25/-
,, furnace	14/- to 15/-
Durham and Northumberland—	
,, foundry	13/-
,, furnace	13/-
Midlands, foundry	—
,, furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 box		13/6
,,	28×20 ,,		27/-
,,	20×10 ,,		20/-
,,	18⅞×14 ,,		14/6
C.W.	20×14 ,,		13/-
,,	28×20 ,,		27/-
,,	20×10 ,,		19/7½
,,	18⅞×14 ,,		14/6
Terneplates	28×20		27/6 per box basis f.o.b.

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6	0	0	to	£7	10	0
Bars, hammered, basis	£17	10	0	to	£18	10	0
Bars and nail-rods, rolled, basis	£15	17	6	to	£16	15	0
Blooms	£10	0	0	to	£12	0	0
Keg steel	£32	0	0	to	£33	0	0
Faggot steel	£20	0	0	to	£24	0	0
Bars and rods dead soft, st'l	£11	0	0	to	£14	0	0

All per English ton, f.o.b. Gothenburg.

TUBES AND FITTINGS.

Current Discounts.

	Tubes.	*Fittings.*
Gas	62½%	57½%
Water ..	58½%	52½%
Steam ..	55%	47½%

W.I. 12½% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.		
July	9 ..	34	0	0	dec.	20/-
,,	10 ..	34	17	6	inc.	17/6
,,	13 ..	33	17	6	dec.	20/-
,,	14 ..	33	11	3	,,	6/3
,,	15 ..	33	5	0	,,	6/3

Electrolytic Copper.

		£	s.	d.		
July	9 ..	37	10	0	dec.	20/-
,,	10 ..	37	10	0	No change	
,,	13 ..	37	0	0	dec.	10/-
,,	14 ..	36	0	0	,,	20/-
,,	15 ..	36	0	0	No change	

Standard Tin (cash).

		£	s.	d.		
July	9 ..	113	0	0	dec.	5/-
,,	10 ..	114	0	0	inc.	20/-
,,	13 ..	108	10	0	dec.	110/-
,,	14 ..	109	10	0	inc.	20/-
,,	15 ..	107	15	0	dec.	35/-

Tin (English ingots).

		£	s.	d.		
July	9 ..	114	0	0	dec.	20/-
,,	10 ..	115	0	0	inc.	20/-
,,	13 ..	109	15	0	dec.	105/-
,,	14 ..	110	15	0	inc.	20/-
,,	15 ..	109	5	0	dec.	30/-

Zinc Sheets (English).

		£	s.	d.		
July	9 ..	20	0	0	No	change
,,	10 ..	20	0	0	,,	,,
,,	13 ..	20	0	0	,,	,,
,,	14 ..	20	0	0	,,	,,
,,	15 ..	20	0	0	,,	,,

Spelter (ordinary).

		£	s.	d.		
July	9 ..	11	15	0	dec.	7/6
,,	10 ..	12	7	6	inc.	12/6
,,	13 ..	12	7	6	No change	
,,	14 ..	12	13	9	inc.	6/3
,,	15 ..	12	7	6	dec.	6/3

Lead (English).

		£	s.	d.		
July	9 ..	13	15	0	dec.	10/-
,,	10 ..	14	0	0	inc.	5/
,,	13 ..	14	0	0	No chang	
,,	14 ..	14	0	0	,,	,,
,,	15 ..	13	15	0	dec.	5/-

Imports and Exports of Iron Castings in June and the six months 1931, compared with June and the six months 1930.

	June, 1930.	June, 1931.	Six months, 1930.	Six months, 1931.	June, 1930.	June, 1931.	Six months, 1930.	Six months, 1931.
Imports.	Tons.	Tons.	Tons.	Tons.	£	£	£	£
Pipes and Fittings, Cast	1,549	1,004	11,898	6,490	19,967	11,980	143,461	84,284
Castings, in the Rough, Iron	205	111	1,274	900	5,345	2,058	28,458	18,261
,, ,, ,, Steel	1,244	294	7,933	3,145	29,893	6,337	186,612	67,149
Hollow-ware, Cast, not Enamelled	3	10	17	38	202	671	1,787	2,704
,, ,, Enamelled	5	1	16	37	247	83	929	1,713
Exports.								
BUILDERS' CASTINGS—								
To Argentine Republic	260	96	1,173	488	12,695	4,838	49,272	21,562
,, British South Africa	135	174	1,087	960	4,911	7,019	43,672	38,074
,, ,, India	74	109	787	723	2,984	3,923	29,027	25,089
,, Australia	12	2	223	55	691	198	13,163	2,596
,, New Zealand	59	21	553	235	3,244	1,081	32,785	14,518
Total (including other countries)	1,264	1,090	8,878	6,430	58,247	48,060	396,047	288,480
PIPES AND FITTINGS—CAST—								
To Argentine Republic	1,775	295	8,545	3,383	18,573	3,129	83,151	32,620
,, British South Africa	381	368	4,264	4,677	5,114	3,401	47,960	54,229
,, ,, India	80	74	1,781	854	1,369	1,056	26,147	15,182
,, Straits Settlements and Malay States	878	80	3,197	901	7,013	1,262	30,023	12,397
,, Ceylon	403	78	843	351	3,292	699	8,505	4,789
,, Australia	14	11	510	94	485	297	9,148	1,935
Total (including other countries)	8,207	5,070	61,452	37,076	94,511	54,462	683,066	423,555
HOLLOW-WARE—								
Cast, not Enamelled, and Cast, Tinned	257	165	2,106	1,154	8,990	5,403	67,783	39,763
,, Enamelled	57	54	375	270	4,633	4,327	32,932	26,808
CASTINGS, in the rough—								
Iron	80	414	1,255	1,177	3,734	6,209	37,870	29,571
Steel	201	75	1,137	730	9,573	3,168	45,986	24,953

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Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

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